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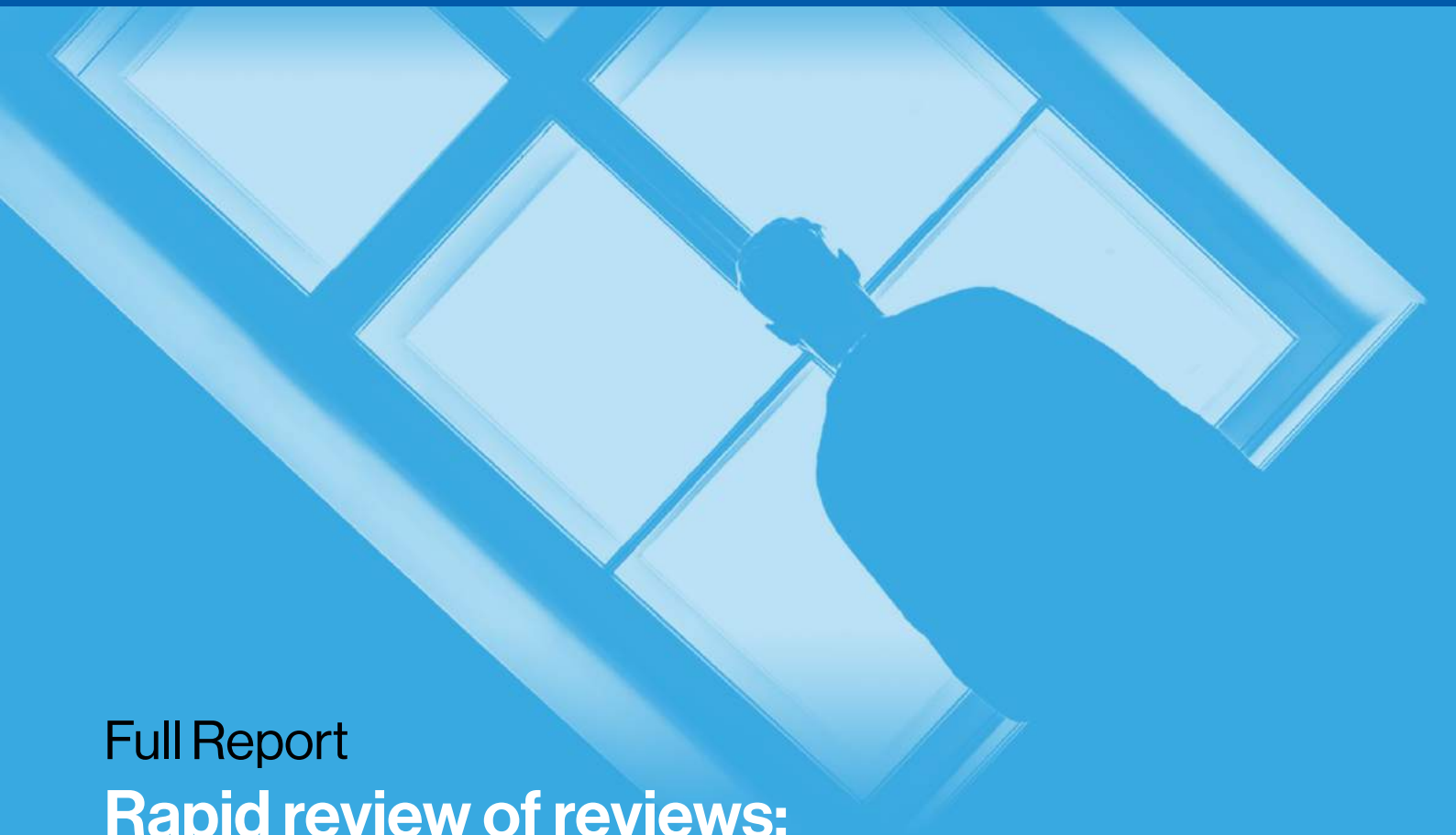

Full Report

Rapid review of reviews: what remotely delivered interventions can reduce social isolation and loneliness among older adults?

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Main messages

During the 2020 coronavirus (COVID-19) crisis, millions of older adults (70+) across the UK (and elsewhere) are being advised to be particularly stringent about social distancing, and to avoid contact with those outside their household. Older adults are already more likely to have long-term illness or disability, to live alone and to be widowed, all of which are risk factors for loneliness. Social distancing places them at even higher risk than normal of social isolation and loneliness, which can adversely affect quality of life, wellbeing and mental health, and are associated with physical ill health and mortality. However, what works to prevent or mitigate loneliness is less clear. The requirement for older adults to restrict their activities during the COVID-19 pandemic has put a spotlight on the need to understand how to minimise the impact of loneliness and isolation.

In the voluntary and community sector, many existing social care services are no longer operating as conventionally commissioned and there is a shift to providing remote support instead, often via the telephone. The call for NHS Volunteer Responders includes roles to make 'regular phone calls to check on people isolating at home', which means that there is a need to ensure that the programmes and interventions that will be staffed by these volunteers are effective and have minimal adverse consequences for older people; and that the volunteers are adequately trained and supported to fulfil these roles.

Our interest here, against a backdrop of mandatory social distancing, is to understand how remote interventions may be effectively delivered. The question of whether remotely delivered interventions can be as effective as face-to-face interventions is not considered in this report.

We followed a 'review of reviews' methodology to synthesise evidence from related (but differing) remote interventions for social isolation and loneliness, to help inform decisions about different approaches. In this rapid review of reviews, we find that:

- **Supported video-communication interventions** are regarded positively by older adults and have positive effects on loneliness and social support.
- **Telephone befriending** has not been widely researched, but qualitative studies suggest improvements in loneliness and social isolation.
- **Online discussion groups and forums** are less clear with mixed results, with increases in social support, but less evidence for improvements in loneliness.
- The evidence for **social networking sites** is weak.
- **Multi-tool interventions** (PC, training, messaging, chat groups) show decreases in loneliness, but not always increases in social support. Interventions vary greatly, making it difficult to isolate the effective elements.
- Concepts of loneliness and social isolation vary, making comparisons and conclusions challenging.
- Detailed analysis of the intervention components, which focussed mainly on social support (an indicator of social isolation), shows that following characteristics are present in effective interventions:
    - **Supporting development of close relationships**
    - **Supporting interactions through ensuring participants share experiences/characteristics**
    - **Support interactions through pastoral guidance**

The findings from this review do not lead us to recommend particular modes of delivering befriending, social support, or low intensity psychological interventions (e.g. videoconferencing, telephone calls, chat rooms or forums), but they do suggest that the characteristics identified through the detailed analysis of components should be incorporated into the delivery of an intervention.

Executive summary

Background

During the 2020 coronavirus (COVID-19) crisis, millions of older adults (70+) across the UK (and elsewhere) are being advised to be particularly stringent about social distancing, and to avoid contact with those outside their household. Older adults are already more likely to have long-term illness or disability, to live alone and to be widowed, all of which are risk factors for loneliness. Social distancing places them at even higher risk than normal of social isolation and loneliness, which can adversely affect quality of life, wellbeing and mental health, and are associated with physical ill health and mortality. However, what works to prevent or mitigate loneliness is less clear. The requirement for older adults to restrict their activities during the COVID-19 pandemic has put a spotlight on the need to understand how to minimise the impact of loneliness and isolation.

In the voluntary and community sector, many existing social care services are no longer operating as conventionally commissioned and there is a shift to providing remote support instead, often via the telephone. The call for NHS Volunteer Responders includes roles to make 'regular phone calls to check on people isolating at home', which means that there is a need to ensure that:

(i) the programmes and interventions that will be staffed by these volunteers are effective and have minimal adverse consequences for older people; and

(ii) the volunteers making phone calls and providing other forms of support are adequately trained and supported to fulfil these roles. Training and guidance are essential to equip volunteers to support others, and measures need to be put into place to support the retention of trained volunteers.

What did we set out to do?

We set out to review the evidence on interventions that seek to ameliorate loneliness or social isolation, or both, through remote interventions. Against a backdrop of mandatory social distancing, our interest was to understand how remote interventions may be effectively delivered. The question of whether remotely delivered interventions can be as effective as face-to-face interventions was not considered.

- We followed a 'review of reviews' methodology with a view to synthesising evidence from related (but differing) remote interventions for social isolation and loneliness, to help inform decisions about different approaches. We sought to synthesise evidence presenting descriptive characteristics, using narrative synthesis, Intervention Component Analysis (ICA), Qualitative Comparative Analysis (QCA)[1], and through creating evidence maps.

[1] ICA is an approach to understanding why trials succeed or fail through drawing on informal evidence published in trial reports; Qualitative Comparative Analysis (QCA) is an approach for categorising studies into sets of 'unsuccessful' (less effective) and 'successful' (most effective) studies and examining the distinct characteristics of successful sets of studies.

To help to identify studies as systematic reviews, we drew on the Database of Abstracts of Reviews of Effects (DARE) criteria. Inclusion criteria for our review of reviews were, broadly:

- Population: older adults (50+); community dwelling; socially isolated, or at risk of loneliness.
- Intervention: befriending, social support, or low intensity psychological interventions (e.g. iCBT (internet Cognitive Behavioural Therapy)), delivered remotely (e.g. by telephone, videoconferencing, online interaction, social networks).
- Comparator: most forms of control group (randomised and non-randomised) and those without a control group (pre-post designs). Reviews focussed on the implementation of interventions, including qualitative evidence syntheses were also in scope, to identify mechanisms of interest for parts of the later synthesis.
- Outcome: measures of loneliness, social isolation (or close proxy measures e.g. social contact).

What do we mean by social isolation and loneliness?

- We conceptualise loneliness as an emotional response within individuals when there is a deficit between their desired and actual quality and quantity of social engagement and relationships.
- We define social isolation as having minimal quantity and quality of both structural support (i.e. the number and diversity of social contacts and social roles in one's life) and functional support (i.e. the meaningful functions that these social relationships play in supporting and enriching one's life). The social networks of socially isolated people therefore involve few people with infrequent meaningful contact with those people.

Findings

How many existing reviews did we identify?

From a total of 2057 records screened manually on title and abstract, 75 were selected for full text screening. Of these, nine existing systematic reviews were relevant for this piece of work. In view of the need for rapid evidence synthesis, we prioritised five of the included reviews for further synthesis, as the remaining four were focussed solely on caregivers and not on the general older adult population. The five reviews included 18 primary studies (reporting 16 different interventions) that met our inclusion criteria (out of a total 112 studies included in the five reviews). The reviews covered a range of populations, using different definitions and age thresholds for 'older adults', with a combined age range of 50-95. The settings were not always clearly stated, but were primarily older adults' own homes, nursing homes, or supported living facilities, in North America, Europe and Taiwan. A variety of study designs were included in the reviews, with randomised controlled trials (RCTs), quasi-experimental cohort studies, survey studies, and qualitative studies (semi-structured interviews and focus groups) all represented.

The interventions reported in the 18 primary studies fell into five categories:

- Supported videoconferencing to alleviate loneliness.
- Telephone befriending to reduce social isolation.
- Online discussion groups/forums to reduce social isolation and/or loneliness, or to improve/maintain social connectedness.
- Supported use of social networking sites for mitigating social isolation and loneliness.
- Multi-tool interventions (provision of equipment, training, messaging, chat groups) to reduce loneliness or social isolation, or increase social connectedness.

Are different modes of remote intervention effective?

Concepts of loneliness and social isolation vary between studies, making comparisons and conclusions challenging. Nevertheless, findings from the narrative synthesis indicate that:

- **Supported video-communication interventions** were regarded positively by older adults, with some evidence of decreases in feelings of loneliness and increases in social support scores.
- **Telephone contact** was only used in two studies. Qualitative findings showed reduced feelings of loneliness and social isolation. Older adults felt more connected to others and were more able to cope.
- **Online discussion groups and forums** showed mixed results with regard to loneliness and social isolation. The majority of studies showed increases in social support, but only two showed reductions in loneliness, with four studies not measuring loneliness at all.
- **Social networking sites** have the potential to reduce loneliness in older adults, but the evidence here is weak. Perceived value and the strength of ties within a social networking site appeared to be issues for older adults.
- **Multi-tool interventions** included in this review demonstrated significant decreases in loneliness, but not always increases in social support. The nature and content of these interventions varied, so it is difficult to isolate the effective elements.

Which processes are aligned with the most successful interventions?

Findings from the Qualitative Comparative Analysis demonstrate that all of the following characteristics are most effective:

- **Supporting development of close relationships:** Intervention supports participants to express feelings freely and without self-consciousness (e.g. opportunities for unstructured discussions with peers).
- **Supporting interactions through ensuring participants share experiences/characteristics:** Target population has shared experience (e.g. being a carer, stroke survivor etc.) and shared characteristics (e.g. women only, people of similar age / socioeconomic status, etc.).
- **Support interactions through pastoral guidance**: Services include some form of pastoral care (e.g. light-touch oversight of a discussion forum by professionals or opportunities for participants to contact professionals for advice).

Other processes around ensuring that participants feel that their participation is beneficial for others as well as themselves, ensuring participants have a stake in the intervention design or the way they can participate, and ensuring that participants can take part through different channels and modes (i.e. in real time and asynchronous modes), may also be important and were more frequently observed in successful interventions. However, successful interventions tended to ensure that all three processes above took place in the intervention. Taken together, these can serve as design principles for future interventions. Unsuccessful interventions either did not ensure all three processes took place simultaneously, or were ones where none of the processes took place.

What are the caveats to these findings?

In addition to the specific limitations set out in detail in the full report, three important caveats to the evidence should be borne in mind when considering the findings:

- This report does not suggest that remotely delivered interventions can be more, equally, or less effective than face-to-face interventions. This review was developed in the context of the COVID-19 pandemic where face-to-face contact was prohibited in large parts of the world because of social distancing rules. With face-to-face social isolation and loneliness interventions being impractical, the focus is therefore on identifying effective ways of delivering remote interventions.
- Remote interventions require sets of circumstances for implementation that are necessary for delivery. In other words, without a certain set of circumstances being in place, the intervention would not run. For example, in the case of internet discussion forums, older people need to have an internet connection, access to a computer, smartphone or tablet, and the IT skills to access the forum and contribute fully. In the case of telephone befriending interventions, older people need to have access to a phone which may need to be internet enabled, and be able to use the phone in a way that allows them to fully participate. These necessary conditions are in addition to other factors such as making adaptations for older people with sensory deficits. How these necessary conditions are established is not directly considered here, and requires further examination.
- This study is a rapid overview of existing systematic reviews. This presents three important limitations. Firstly, not all of the studies included in the reviews are relevant to the research questions we wish to address (see details of our inclusion criteria); we overcome this limitation by focussing on a subset of more relevant interventions. Secondly, the review of reviews approach means that new studies will have been published since our most recent included review. However, we believe that the focus on theory and understanding the consistent processes through the QCA may go some way to mitigate this, and that the substantive messages are likely to remain salient. Finally, a rapid approach increases the risk of studies not being identified and there being flaws in the data extraction, synthesis and interpretation. While the processes we employed were designed to minimise this risk, this limitation remains inherent to any rapid approach.

What should come next?

The findings from this review do not lead us to recommend particular modes of delivering befriending, social support, or low-intensity psychological interventions (e.g. videoconferencing, telephone calls, chat rooms or forums), but they do suggest that the principles outlined above should be incorporated into the delivery of an intervention. Although we believe all of the intervention modes in scope here have the capacity to include the processes found to lead to more successful interventions (supporting the development of intimate relationships; supporting interactions through ensuring participants share experiences/characteristics; provide pastoral guidance), a more encompassing piece of research is needed in order to identify which mode is most effective, or has the greatest potential, for changing outcomes. A starting point to this may be in understanding how interventions incorporate these processes in their design, and where there is scope for their enhancement through engagement with voluntary sector and other providers.

1 Context

1.1 Policy issue/problem

This review focusses on interventions that seek to ameliorate loneliness or social isolation, or both.

- We conceptualise loneliness as an emotional response within individuals when there is a deficit between their desired and actual quality and quantity of social engagement and relationships (Victor et al., 2005, p64).

- We define social isolation as 'having minimal quantity and quality of structural and functional support' which can involve having social networks of low density that are not maintained through frequent engagement (Hayanga et al., 2020, p15). Structural support reflects the number and diversity of social contacts and social roles in one's life; functional support reflects the meaningful functions that these social relationships play in supporting and enriching one's life. The social networks of socially isolated people therefore involve few people and infrequent meaningful contact with those people.

Both loneliness and social isolation are conceptually distinct from living alone, the latter having limited utility as a proxy for either social isolation or loneliness (Smith and Victor, 2019).

Older adults are more likely to have long-term illness or disability, to live alone and to be widowed, all of which are risk factors for loneliness (Pyle and Evans, 2018). During the coronavirus (COVID-19) crisis (current at the time of writing in May 2020), millions of older adults (70+) across the UK (and elsewhere) are being advised to be particularly stringent about social distancing, and to avoid contact with those outside their household (PHE, 2020). This places older adults at even higher risk than usual of social isolation and loneliness. Social isolation and loneliness adversely affect quality of life, wellbeing and mental health, and are associated with physical ill health and mortality (Steptoe et al., 2013). However, what works to prevent or mitigate loneliness is less clear; the same argument also applies to social isolation, although is further complicated by numerous different approaches to the way in which it is conceptualised and measured. The requirement for older adults to restrict their activities during the COVID-19 pandemic has put a spotlight on the need to understand how to minimise the impact of loneliness and isolation.

A number of evidence reviews have highlighted the diverse range of interventions to address and alleviate loneliness (and its consequences) amongst older adults in a variety of settings (Cattan et al., 2005, Victor et al., 2018). In the main, these have been face-to-face interventions, either in groups or between individuals. Given the social distancing measures in place at the time of writing, these face-to-face interventions are not possible. Much of our social contact now has to be conducted remotely: over the telephone, through use of videoconferencing tools, or through other internet 'chat' facilities. Corresponding approaches taken by interventions delivered remotely for reducing the risk of social isolation or loneliness could include befriending models or using internet chat facilities to foster social support.

In the voluntary and community sector, many existing social care services are no longer operating as conventionally commissioned (e.g. day services, home visits from befrienders,

shopping and cleaning services) and there is a shift to providing remote support instead, often via the telephone. The call for NHS Volunteer Responders includes roles to make 'regular phone calls to check on people isolating at home', through the GoodSAM app (NHS, 2020). Whilst the public's enthusiastic response to appeals to provide volunteer support to others isolating at home is welcome, there is a need to ensure that:

(i) the programmes and interventions that will be staffed by these volunteers are effective and have minimal adverse consequences for older people; and

(ii) the volunteers making phone calls and providing other forms of support are adequately trained and supported to fulfil these roles. Training and guidance is essential to equip volunteers to support others, and measures need to be put into place to support the retention of trained volunteers.

Additionally, there may be scope to adopt and scale-up remotely delivered low intensity structured psychosocial interventions based on established models of psychological theory and treatment (e.g. CBT, bibliotherapy, and forms of self-help and peer support interventions (NICE, 2011, Bennett-Levy et al., 2010). The advantage of these approaches is that they might be useful in non-clinical populations who are at a high risk of adverse outcomes such as depression or loneliness (Gilbody et al., 2017). For such interventions to be suitable for delivery at scale and within the context of the COVID-19 lockdown, they must be (a) effective; (b) suitable for delivery by telephone/or online, and (c) have a low requirement for training and/or no pre-existing experience as a mental health professional. Our interest here, against a backdrop of mandatory physical distancing, is to understand how remote interventions may be effectively delivered. The question of whether remotely delivered interventions can be as effective as face-to-face interventions is not considered in this report.

1.2 Research aims

This rapid review examines evidence on whether befriending, social support, and low intensity psychosocial interventions delivered remotely can work to ameliorate social isolation or loneliness among older adults.

Specifically, the aims are to:

(i) Identify existing systematic reviews on befriending, social support, and low intensity psychosocial interventions delivered remotely for older adults.
(ii) Synthesise review-level findings on the nature and effectiveness of these interventions.
(iii) Generate new understandings on how interventions work and which core components and processes are associated with successful interventions.
(iv) Map the review- and study-level evidence to better understand evidence gaps.

2 Methods

We followed a 'review of reviews' methodology with a view to synthesising evidence from related (but differing) interventions for social isolation and loneliness, to help inform decisions about different approaches (Hunt et al., 2018).

This review was undertaken with the explicit aim of producing evidence of policy-relevance rapidly, in the context of the current COVID-19 pandemic. Despite the rapid nature of the review, we ensured that quality was not compromised and that the stages of the review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) checklist for the reporting of systematic reviews (Moher et al., 2009). A protocol was agreed before data extraction and published on the EPPI-Centre website.

2.1 Search strategy

Searches of seven bibliographic databases that contain research literature across the fields of health, social care, psychology and social science were carried out on 23rd-24th April 2020. We also searched four other online resources that contain systematic reviews in these areas. We searched: Applied Social Sciences Index and Abstracts (ASSIA)(Proquest), Emerging Sources Citation Index (Web of Science), Database of Promoting Health Effectiveness Reviews (DoPHER), Epistemonikos, Medline (OVID), NHS Evidence, PsycInfo (OVID), Social Policy and Practice (OVID), Social Sciences Citation Index (Web of Science), Social Systems Evidence and Sociological Abstracts (Proquest).

The search strategy was developed and implemented by an information specialist (CS) in collaboration with a joint-lead reviewer (DK) and contributions from the others in the review team.

The search terms reflected four concepts that needed to be present each of the study citations:

1) **Population:** older and middle-aged populations aged 50+ years.
2) **Interventions** that enable remote delivery: technology, remote communication, telephone, helplines, self-help, bibliotherapy.
3) **Outcomes:** loneliness, social isolation (or close proxy measures e.g. social contact).
4) **Study designs:** systematic reviews and reviews of reviews.

Synonyms for each of these concepts were used to search title, abstract, keyword, journal and controlled vocabulary fields of the databases in order to try to capture a wide range of systematic reviews. The search strings were informed by previous systematic searches, notably Burchett et al. (in preparation), Dickson et al. (2019), and NICE (2018); topic knowledge of the review team; and test searches and examination of potentially relevant reviews. The search history for Medline is presented in Appendix 1. While the search aimed to be comprehensive, systematic reviews that do not explicitly describe the four elements of search (intervention mode, population or outcomes or study design) in their citation and abstract will be missed by these searches.

2.2 Inclusion and exclusion criteria

Inclusion and exclusion criteria were based on the Population, Intervention, Comparator, Outcome and Study Design (PICOS) framework and these elements are described in detail below:

2.2.1 Population (participants)

We included reviews focussed on older adults. We used a broad definition of 'older' adults (50+) that includes people moving between middle and older ages, to reflect a breadth of circumstances in terms of economic activity, family structures, living circumstances and health that are experienced in the later life course.

Participants had to be located in community settings (i.e. people's own homes including general purpose housing, sheltered housing, extra care housing, independent living facilities etc.) or in residential care settings. Reviews of interventions delivered to older adults in hospital settings were excluded.

Reviews focussed on particular groups of the population (e.g. caregivers) or sections of the population at particularly high risk of social isolation or loneliness, such as bereaved people or those with long-term health problems (e.g. dementia), were included provided that most of the participants met our criteria around age. Studies included in reviews were expected to include those who are socially isolated, lonely, or who are otherwise at risk of loneliness or isolation.

2.2.2 Intervention

Included reviews examined interventions that seek to reduce levels of social isolation or loneliness. These interventions may seek to achieve this through strengthening individuals' social contacts and social relationships (e.g. befriending and social support interventions) or through low intensity psychosocial interventions (e.g. internet-delivered CBT - iCBT), using remote methods and technologies. These may be offered on a one-to-one basis through befriending or other forms of social contact and social support, or remote group-based interventions (e.g. remote book clubs). We did not include interventions that examined the use of social robots, pets or virtual pets in alleviating loneliness/social isolation.

Our focus was therefore on interventions that focus on either on (i) improving participants' interpersonal communication skills (social skills training); (ii) providing regular contacts, care, or companionship (enhancing social support); (iii) increasing opportunities for participants to engage in social interaction (offering social access); or (iv) changing participants' social cognition (social cognitive training) (Masi et al., 2011). In doing so we mirrored the focus of previous systematic reviews of loneliness interventions, albeit with a specific interest in interventions that are delivered remotely (Masi et al., 2011).

All included reviews focussed on the delivery of the intervention through remote means. This can include more traditional telephone-based interventions, as well as smartphone and online interventions. Reviews could include interventions that use social network or social media applications to support one-to-one interactions, or to support group-based interactions (e.g. forms of video conferencing). Reviews that focused on models of intervention that involve physical contact with those outside the household as a crucial component were not included.

We excluded reviews solely focused on the use of Information and Communications Technology (ICT) for educational or training purposes. These interventions tend to involve teaching older people how to use the internet (with classes delivered in homes or community centres). These interventions were deemed to be of lesser interest as they tend to focus on technology skill development as opposed to focussing more directly on social isolation or loneliness, although improvement in isolation/loneliness may be indirect or marginal benefits in some cases. Developing technical skills maybe a necessary precursor to participation in several of the studies considered here, although exploration of this aspect leads to a different, albeit linked, research focus around optimal ways of developing technical skills allowing online and phone participation among older people, and not around understanding the benefits and ways of organising this participation.

2.2.3 Comparator/control

We included reviews focussed on studies with most forms of control group (randomised and non-randomised) and those without a control group (pre-post designs). Reviews focussed on the implementation of interventions, including qualitative evidence syntheses were also included, to identify mechanisms of interest for parts of the later synthesis. We excluded reviews of case reports or reviews of intervention theory.

2.2.4 Outcomes

Included reviews must have measured social isolation or loneliness as a primary outcome, or closely related measures commonly used as proxy indicators (such as social contacts or social support). Data on the impact of the interventions on social isolation and/or loneliness were extracted, in addition to the calculation of effect sizes from any statistical associations reported.

Based on previous work in the area, we expected various measures of loneliness and social isolation to be reported in studies. These included validated measures of loneliness (e.g. De Jong Gierveld (De Jong-Gierveld and Kamphuls, 1985) and UCLA scales (Russell et al., 1980)) and validated measures of certain aspects of social isolation (e.g. the Lubben social network scale (Lubben et al., 2006)). However, validated and encompassing measures of social isolation in particular are comparatively rarely used, and we planned to draw on proxy measures, for example reports of contact with family and friends and levels of social support, where appropriate. This is in accordance with conceptualisations of social isolation elsewhere, for example with social support being viewed as indicative of individuals' everyday social worlds and a key indicator of social isolation in several studies (see, for example Cornwell and Waite, 2009).

Secondary outcomes of interest in this review included evidence of any adverse impacts (e.g. increase in health inequalities), and outcomes around implementation (e.g. acceptability, adherence, dosage) or cost-effectiveness.

2.2.5 Study design

To help to identify studies as systematic reviews, we drew on the Database of Abstracts of Reviews of Effects (DARE) criteria (CRD, 2014), and included studies that met at least four of the following criteria:

1. Were inclusion/exclusion criteria reported?
2. Was the search adequate?
3. Were the included studies synthesised?
4. Was the quality of the included studies assessed?
5. Were sufficient details about the individual included studies presented?

We did not include any other reviews of reviews, but did attempt to use these to identify any additional systematic reviews as appropriate. We sought to include reviews of intervention outcomes and/or implementation, including qualitative syntheses of mechanisms of intervention effects. Unusually, a number of reviews combined both intervention and observational studies. Reviews that were peer reviewed and published in journals as well as unpublished manuscripts (e.g. PhD theses) were eligible.

2.2.6 Other inclusion/exclusion criteria

Additional criteria around the type of review and language (studies in English) were also used to select studies (see Appendix 2).

2.3 Study selection

We exported search records to EPPI-Reviewer (Thomas et al., 2010) and started selection through de-duplicating the records. Title and abstract screening was undertaken independently by three reviewers (DK, EB, PH) following joint screening of 204 citations (10%) to ensure consistency of each reviewer in applying the eligibility criteria. For those records marked for full-text screening, we obtained full texts for each of these records for assessment. Each full-text record was examined in duplicate, and reviewers met online to reconcile any differences. Reasons for exclusion are reported in Figure 1.

Systematic reviews in this area often include a mix of eligible and ineligible interventions. As was the case in previous overviews focussed in this area (Chipps et al., 2017), and in addition to the criteria outlined above, systematic reviews were included if they:

(i) contained only interventions focussed on befriending, social support, and low intensity psychosocial interventions delivered remotely to reduce social isolation and loneliness among older adults; or
(ii) contained a majority of interventions focussed on befriending, social support, and low intensity psychosocial interventions delivered remotely to reduce social isolation and loneliness among older adults; or
(iii) contained separate evidence tables, or defined sections of evidence tables, presenting evidence on interventions focussed on befriending, social support, and low intensity psychosocial interventions delivered remotely to reduce social isolation and loneliness among older adults; or
(iv) contained separate synthesis sections presenting evidence on interventions focussed on befriending, social support, and low intensity psychosocial interventions delivered remotely to reduce social isolation and loneliness among older adults.

We did not include reviews where only a single study would meet our criteria (this decision applied to only one review encountered, see results). Because not all the evidence in the included reviews may be relevant for the overall research questions, we present both synthesis at a review level and at the individual study level (see later section on synthesis). Individual studies reported within systematic reviews were identified as relevant, using the same inclusion criteria as above (albeit applied at the study, not review level) and after agreement of two reviewers.

2.4 Data extraction

Data extraction frameworks were developed to code evidence from the included systematic reviews according to key characteristics. Data were extracted by two reviewers and any differences agreed in online reconciliation meetings. Extracted review-level data are shown in Box 1.

In addition, further extraction took place from the relevant primary studies included within the reviews. As above, this was conducted in duplicate, with two reviewers extracting information on primary studies, either directly from the reviews, or where information had not been included in sufficient detail, directly from the studies themselves.

For the planned synthesis examining how interventions work, further data extraction took place around a subset of primary studies to enable identification of intervention

mechanisms using Intervention Component Analysis (ICA) and Qualitative Comparative Analysis (QCA).

Box 1: Extracted review-level data

Lead author and team	Target population (e.g., if focussed on particular group e.g. bereaved older people)
Year of publication	Participant characteristics (e.g., age, gender)
Number of primary studies included in the review	Intervention approaches in primary studies (e.g., type of remote intervention)
Number of primary studies of interest included in the review	Synthesised outcomes/Key findings relating to Social Isolation and/or Loneliness; secondary outcomes relating to implementation and adverse effects
Primary study design(s) (e.g., RCT studies, qualitative studies)	Quality assessment characteristics and rating
Aims of review and main topic focus; (e.g. if focussed on social isolation/loneliness)	

2.5 Critical appraisal

Included systematic reviews were critically appraised using AMSTAR-2 (Shea et al., 2017) by two reviewers (DK/BH and EB/PH). Criteria were summed and categories of quality created based on the AMSTAR-2 assessment (low risk of bias (equivalent to high confidence in AMSTAR-2), unclear (equivalent to moderate confidence) and high risk of bias (equivalent to low or critically low confidence). Although we planned to use GRADE-CERQual (Lewin et al., 2018) to assess confidence in qualitative evidence syntheses, no such reviews were identified. All meetings to discuss and agree critical appraisal (and screening) were conducted remotely due to the COVID-19 pandemic.

2.6 Data synthesis

Systematic reviews that were focussed on specific populations – namely caregivers – were eligible for inclusion in this review. However, owing to the rapid nature of the review, and the requirement for evidence that would shape thinking in the context of the current COVID-19 pandemic, we focussed our attention in all synthesis stages on reviews that were not focussed on any single population of older people (this meant we did not synthesise evidence from reviews of interventions conducted *exclusively* with caregivers, see description of results). Our evidence nevertheless examines interventions conducted across a wide spectrum of older people, including caregivers.

2.6.1 Descriptive analysis of reviews and studies

We undertook descriptive analysis of the reviews to develop a preliminary understanding of the evidence through producing textual descriptions of the reviews and their findings and presenting this in tabular form. The results also helped to populate an evidence map (see later synthesis).

2.6.2 Narrative synthesis of the evidence

A rapid narrative synthesis was conducted to examine review-level and study-level findings. Whereas the descriptive synthesis focussed on describing the type of evidence available and where interventions had been conducted and among whom, the narrative synthesis focussed more in-depth on the outcomes of befriending, social support, and low intensity psychosocial interventions delivered remotely. Building on the descriptive analysis, and following guidance outlined elsewhere (Snilstveit et al., 2012), we:

1. Identified key themes from the findings of selected reviews to develop an understanding of the topics covered and the outcomes synthesised, identifying interventions showing significant effects.
2. Identified connections between different systematic reviews, through developing a framework for understanding different groupings and clusters of reviews (see typologies of interventions presented in the results). We then sought to understand similarities and differences in findings and interpretation between systematic reviews that are closely related in terms of topic area. A particular challenge of conducting overviews or reviews of systematic reviews is that studies included in one review overlap with studies included in another (Hunt et al., 2018). This step of synthesis of identifying connections between reviews is particularly helpful in identifying the extent of overlap in included reviews (i.e. studies occurring in more than one review).
3. Finally, we developed a common rubric to describe the findings. We also considered the robustness of the synthesis methods and the quality of evidence in terms of its relevance to the aims of the review.

We had planned to focus on evidence from higher quality reviews only, identified from our critical appraisal. However, owing in part to the (low) quality of several of the included reviews (see Table 2), we focussed on those reviews that were most closely aligned with the ambitions of the present study and the anticipated use of the findings.

2.6.3 Intervention Component Analysis and Qualitative Comparative Analysis

We drew on two complementary synthesis methods - Intervention Component Analysis (ICA) and Qualitative Comparative Analysis (QCA) - to better understand how successful interventions 'worked' in order to inform the design of future interventions and programmes. Both approaches were first applied to systematic reviews by members of the research team (KS and JT respectively).

The first approach, ICA (Sutcliffe et al., 2015), is an inductive approach developed in response to the poor reporting of intervention processes that is common across the literature (Hoffmann et al., 2014). It involves (a) inductively coding the nature of intervention features (i.e. components) and (b) using trialists' informally-reported experience-based evidence (i.e. information usually located in introduction and discussion sections of trial reports, which is usually not incorporated into analysis) (Sutcliffe et al., 2015). This information is then used in conducting the QCA.

The second approach, QCA, is used to synthesise data from a subset of studies. While QCA is named as a qualitative technique, it involves numeric data and is based on set-theory, set-theory being mathematical theory of well-determined collections, called sets, of objects that are called members, elements, or cases (Schneider and Wagemann, 2012). QCA is increasingly employed as a solution to the challenge of analysing data containing a small number of cases (i.e. studies), each with an extensive array of factors that may trigger a given outcome (Ragin, 2008). This 'small N-many variables' challenge is similar to that often faced by systematic reviewers, and Thomas and colleagues provide one of the first examples where QCA was utilised within a systematic review to understand configurations of intervention components that were aligned with "successful" interventions (Thomas et al., 2014). The goals of QCA have been described as integrating the best features of the 'case-oriented' approach, involving developing an in-depth knowledge of individual studies, with the best features of a 'variable-oriented' approach, where the focus is on comparing studies and identifying cross-case patterns in the data (Rihoux, 2009).

Our first step in conducting the QCA was to select a set of cases (studies) to examine, with each primary intervention study meeting our inclusion criteria and reporting quantitative findings potentially eligible (see results). To undertake the QCA, we identified studies as belonging to both 'condition sets' (i.e. belonging to a distinct set of studies distinguished by the presence or absence of different characteristics or processes) and 'outcome sets' (i.e. belonging to a group of studies differentiated by whether they are considered most effective or least effective). Ultimately, we were interested in establishing which condition sets 'overlap' with successful outcome sets. QCA allows us to recognise that there may be different pathways to successful interventions. The goal of QCA is to identify the simplest expression of characteristics/processes that lead to effective interventions; to find the simplest expression we drew on Boolean minimisation. A similar approach involving the reanalysis of studies included within systematic reviews has been trialled earlier, producing novel results and understanding (Melendez-Torres et al., 2018). We followed standards of good practice that have been laid out elsewhere in conducting the QCA (Kneale et al., 2019). Further explanation of the approach is provided alongside the results.

2.6.4 Evidence map and evidence gap map

Using EPPI-Mapper, a subsidiary application of EPPI-Reviewer (Thomas et al., 2010), we produced an interactive map of the included reviews and the included studies of interest, that allows users to explore the evidence, with links to abstracts and full-text articles where available. This is discussed further in the results section. The purpose of the map is to flag where research gaps exist, and to inform the design, conduct, and reporting of further research (Nyanchoka et al., 2019).

3 Results

3.1 Number of reviews and primary studies identified

The database searches and references identified during preliminary scoping work located 2,715 citations (seven identified manually including through backward/forward citation tracing). After duplicates were removed, this left 2,057 citations to screen. Title and abstract screening identified 75 possible studies for inclusion. Full texts were obtained for

all 75 records, and of these nine systematic reviews were identified as relevant to the review. The flow of literature is shown Figure 1 and citation details of included reviews in Table 1.

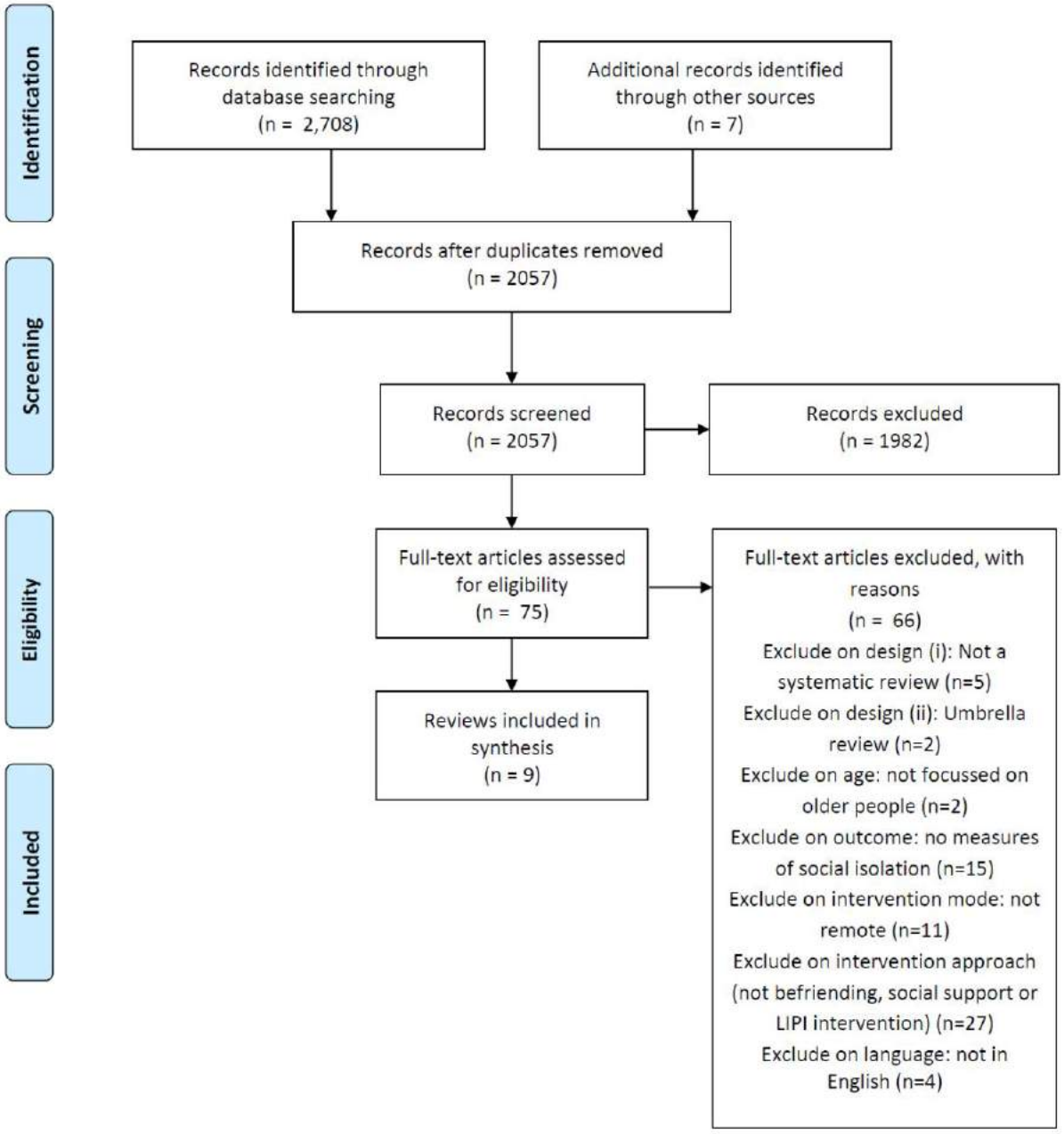

Figure 1: Flow of studies through the review

Table 1: Citation details of reviews identified through screening

Citations for included reviews
Beneito-Montagut, R., Cassián-Yde, N. and Begueria, A., 2018. What do we know about the relationship between internet-mediated interaction and social isolation and loneliness in later life? *Quality in Ageing and Older Adults*. 19(1) pp.14-30.
Bennett, N., 2015. *The Impact of Video-Communication on Older Adults' Psychological Well-Being: A Mixed Methods Study* (Doctoral dissertation, University of Essex).
Chen, Y.R.R. and Schulz, P.J., 2016. The effect of information communication technology interventions on reducing social isolation in the elderly: a systematic review. *Journal of Medical Internet Research*, 18(1), p.e18.
*Corry, M., Neenan, K., Brabyn, S., Sheaf, G. and Smith, V., 2019. Telephone interventions, delivered by healthcare professionals, for providing education and psychosocial support for informal caregivers of adults with diagnosed illnesses. *Cochrane Database of Systematic Reviews*, Issue 5. Art. No.: CD012533.
*Elvish, R., Lever, S.J., Johnstone, J., Cawley, R. and Keady, J., 2013. Psychological interventions for carers of people with dementia: A systematic review of quantitative and qualitative evidence. *Counselling and Psychotherapy Research*, 13(2), pp.106-125.
*Hopwood, J., Walker, N., McDonagh, L., Rait, G., Walters, K., Iliffe, S., Ross, J. and Davies, N., 2018. Internet-based interventions aimed at supporting family caregivers of people with dementia: systematic review. *Journal of Medical Internet Research*, 20(6), p.e216.
Khosravi, P., Rezvani, A. and Wiewiora, A., 2016. The impact of technology on older adults' social isolation. *Computers in Human Behavior*, 63, pp.594-603.
*Lins, S., Hayder-Beichel, D., Ruecker, G., Motschall, E., Antes, G., Meyer, G. and Langer, G., 2014. Efficacy and experiences of telephone counselling for informal carers of people with dementia. *Cochrane Database of Systematic Reviews*, Issue 9. Art. No.: CD009126.
Morris, M.E., Adair, B., Ozanne, E., Kurowski, W., Miller, K.J., Pearce, A.J., Santamaria, N., Long, M., Ventura, C. and Said, C.M., 2014. Smart technologies to enhance social connectedness in older people who live at home. *Australasian Journal on Ageing*, 33(3), pp.142-152.

* Reviews focussed on caregivers.

Four of the reviews focussed entirely on interventions to support caregivers; these reviews are marked by an asterisk in the list above: Corry et al. (2019), Elvish et al. (2013), Hopwood et al. (2018) and Lins et al. (2014). In view of the need for rapid evidence synthesis, we prioritised five of the included reviews for further synthesis as they focussed on the general older population (which included care givers in some instances), as opposed to an exclusive focus on caregivers (see Table 8 in Appendix 3).

Not all of the primary studies within these five reviews met our inclusion criteria, to help us answer our review question and achieve our aims. From the 112 primary studies included across the five reviews, we identified 17 studies to look at in more detail. The

citations are shown in Table 3, and the data extracted from the five reviews and these 18 primary papers are included in Table 8. In the four caregiver-focussed reviews, there were 14 primary studies of interest, to which we could return at a later date, if deemed useful.

3.1.1 Excluded reviews

Of the 75 records screened on full text, 66 were excluded for reasons outlined in Figure 1. Among the reviews that were excluded, some are worthy of highlighting here for future researchers interested in this field: (i) a review of low intensity psychological interventions for older people, excluded because of an absence of social isolation/loneliness outcomes (Cremers et al., 2019); (ii) two reviews of interventions that included a focus on remote interventions but that included no eligible primary studies on befriending, social support or low intensity psychosocial interventions (Baker et al., 2018), or just one (Medical Advisory Secretariat, 2008); (iii) reviews that were focussed on teaching IT skills (for example Choi et al., 2012); and finally a review that included insufficient detail on the studies that were included, although did include a number of studies conducted within the community from local grassroots organisations (Sharma et al., 2018).

3.2 Characteristics of included reviews

3.2.1 Aims

The reported aims of the reviews were as follows:

- To review previous research that investigates the relationship between internet use for communication and social isolation and loneliness, including its effects on social relationships in later life (Beneito-Montagut et al., 2018)[2].
- To answer what impact video-communication has on older adults' existing relationships and their psychological well-being, when it is used to communicate with friends and relatives (Bennett, 2015).
- To explore the effects of ICT interventions on reduced social isolation of older people (Chen and Schulz, 2016).
- To identify ICTs that are designed to help seniors reduce their social isolation and loneliness, and assess the effectiveness of these technologies in supporting seniors' wellbeing (Khosravi et al., 2016).
- To conduct a systematic review of studies that assessed the effectiveness of smart technologies in improving or maintaining the social connectedness of older adults who live at home (Morris et al., 2014).

3.2.2 Populations

The reviews covered a range of populations, using different definitions and age thresholds for 'older adults', with a combined age range of 50-95. The settings were not always clearly stated, but were primarily older adults' own homes, nursing homes, or supported living facilities, in North America, Europe and Taiwan. Whilst some reviews focused on the general older adult population, others included studies of people with multiple chronic

[2] Note that Beneito-Montagut was a self-defined review of the literature but was deemed to meet the core components of a systematic review.

conditions, specific conditions (such as Alzheimer's Disease, or breast cancer), or in a particular geographical area.

3.2.3 Study designs and quality appraisal

A variety of study designs were included in the reviews, with RCTs, quasi-experimental cohort studies, survey studies, and qualitative (semi-structured interviews and focus groups) all represented. Three of the five reviews conducted quality appraisals on the included studies (Bennett, 2015, Chen and Schulz, 2016, Morris et al., 2014), one evaluated only the effectiveness of the technologies within the studies, not the quality of the study itself (Khosravi et al., 2016), and one did not report any quality appraisal (Beneito-Montagut et al., 2018).

3.2.4 Interventions

The reviews contained studies reporting interventions using various technologies to deliver remote befriending, social support or low intensity psychological interventions:

- Computer training.
- Internet training.
- Social network site (SNS) training.
- Training to use computer-mediated communication (bespoke tools, email, Skype, Windows Messenger).
- Internet use.
- SNS use (bespoke, Facebook, MySpace).
- Telephone (landline).
- Video-communication through videophones (landline connections), computer, touch screen device, tablets, multi-function devices and video-communication robots.
- Social Robots.
- Telecare (video-telephone nursing care, Care TV).
- Video games (Nintendo Wii).
- Personal Reminder Information and Social Management System (PRISM).
- Web-based information, intervention and communication programmes.

As discussed above, not all of these intervention modes would meet our own criteria for befriending, social support, and low intensity psychosocial interventions delivered remotely to reduce social isolation and loneliness among older adults.

3.2.5 Outcome measures

There was a range of different measures within the reviews, although all contained some measure of loneliness or social isolation. These included:

- UCLA Loneliness Scale (Russell et al., 1980);
- de Jong Gierveld scale (De Jong-Gierveld and Kamphuls, 1985);
- Geriatric Depression Scale (Yesavage, 1988);
- Social and Emotional Loneliness Scale (DiTommaso and Spinner, 1993);
- OARS Social Resources Rating Scale (Fillenbaum, 2013);
- Social Support Questionnaire (Sarason et al., 1987);

- support network satisfaction (Rook, 1987);
- companionship scale satisfaction (Rook, 1987);
- Multidimensional Scale of Perceived Social Support (MSPSS) Social Support Behaviours Scale, (Zimet et al., 1988);
- Social Satisfaction Scale PROMIS (Bode et al., 2010);
- The Centre for Epidemiological Studies Depression Scale (CES-D) (Lewinsohn et al., 1997);
- Rosenberg Self-Esteem Scale (Rosenberg, 2015).

Various measures of social relationships were administered, including qualitative interviews and social network size. Many studies included in the reviews had no measure of loneliness or social isolation, but measured depressive symptoms or health-related quality of life instead, as a proposed proxy.

3.3 Risk of bias assessment of included reviews

The majority of reviews (6/9) were deemed to be of low or critically low quality (displayed as having a high risk of bias in Table 2). Although all of the included reviews had reasonably clearly defined PICO components and had conducted reasonably comprehensive search strategies, the majority of reviews had failed to prepare a protocol, and many failed to justify the choice of study selection. This latter concern was particularly problematic where authors had included studies of various study designs within their review. Both reviews that had a low risk of bias were published in the Cochrane library and were focussed on interventions for caregivers of older people with chronic illness and dementia.

Table 2: AMSTAR-2 ratings for included systematic reviews (displayed as risk of bias)

Review	1. PICO components	2. Protocol	3. Study design explanation	4. Comprehensive search strategy	5. Duplicate study selection	6. Duplicate data extraction	7. Details of excluded studies	8. Description of included studies	9a. Risk of Bias (RoB) assessment (RCTs)	9b. RoB assessment (NRSIs)	10. Funding sources	14. Heterogeneity	15. Publication bias	16. Reports conflicts of interest	**Overall rating of quality**
(Beneito-Montagut et al., 2018)	+	-	-	?	+	+	?	+	?	-	-	-	?	-	-
(Bennett, 2015)	+	-	-	+	-	-	+	+	?	?	-	+	?	-	-
(Chen and Schulz, 2016)	+	-	+	?	-	+	+	+	?	?	-	+	?	+	-
(Corry et al., 2019)	+	+	+	+	+	+	+	+	+	?	+	+	?	+	+
(Elvish et al., 2013)	+	-	+	?	+	+	?	+	+	?	-	-	?	-	-
(Hopwood et al., 2018)	+	-	-	+	+	+	?	+	+	+	+	+	?	+	?
(Khosravi et al., 2016)	+	-	+	?	+	-	?	?	-	-	-	-	?	-	-
(Lins et al., 2014)	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
(Morris et al., 2014)	+	-	-	?	+	+	?	+	?	?	-	+	?	-	-

+=low risk of bias (equivalent to high confidence); ?=moderate or unclear (equivalent to moderate confidence); - = high risk of bias (equivalent to low or critically low confidence); Note chart shows only those items relevant to all included reviews

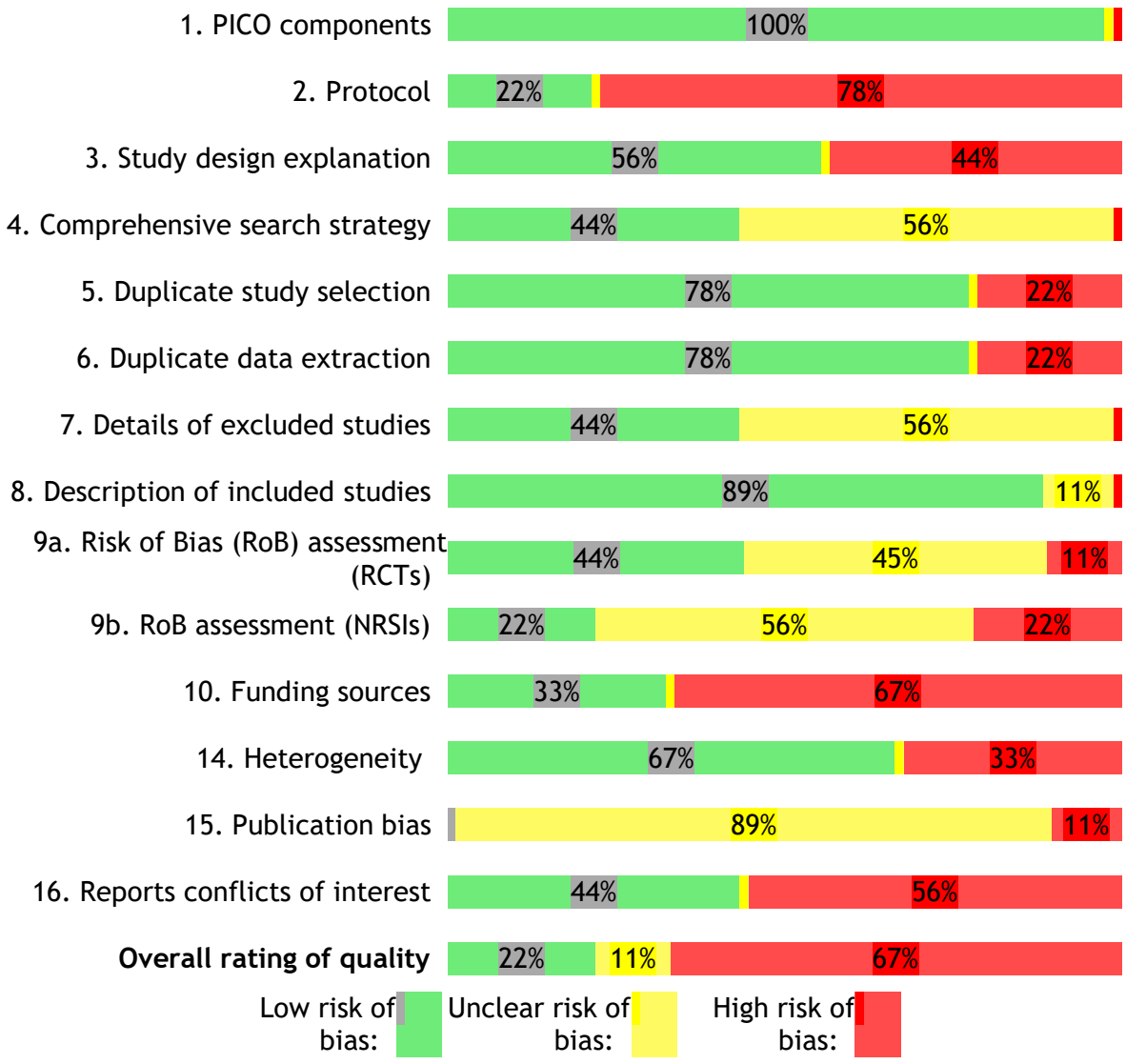

Figure 2: Overall distribution of AMSTAR-2 ratings for included systematic reviews (Note chart shows only those items relevant to all included reviews; Low risk of bias equivalent to high confidence; moderate or unclear equivalent to moderate confidence; high risk of bias equivalent to low or critically low confidence; Note chart shows only those items relevant to all included reviews)

3.4 Characteristics of included primary studies

We reviewed the primary studies included within the five reviews against our inclusion criteria, to identify studies where remote befriending or social support interventions were delivered, and which included some measure of loneliness, social support, or both. From the 112 primary studies included across the five reviews, six duplicates were identified,

leaving 18 manuscripts[3], based on our inclusion criteria. The citations are shown in Table 3, and the data extracted from the five reviews and these 18 primary papers are included in Table 8, in Appendix 3.

Table 3: Primary studies identified within reviews

Citations for relevant primary studies
Ballantyne, A., Trenwith, L., Zubrinich, S. and Corlis, M., 2010. 'I feel less lonely': what older people say about participating in a social networking website. *Quality in Ageing and Older Adults*, 11(3), pp.25-35.
Barrera, M., Glasgow, R.E., McKay, H.G., Boles, S.M. and Feil, E.G., 2002. Do Internet-based support interventions change perceptions of social support?: An experimental trial of approaches for supporting diabetes self-management. *American Journal of Community Psychology*, 30(5), pp.637-654.
Bond, G.E., Burr, R.L., Wolf, F.M. and Feldt, K., 2010. The effects of a web-based intervention on psychosocial well-being among adults aged 60 and older with diabetes. *The Diabetes Educator*, 36(3), pp.446-456.
Cattan, M., Kime, N. and Bagnall, A.M., 2011. The use of telephone befriending in low level support for socially isolated older people–an evaluation. *Health & Social Care in the Community*, 19(2), pp.198-206.
Demiris, G., Oliver, D.R., Hensel, B., Dickey, G., Rantz, M., Skubic, M., 2008. Use of videophones for distant caregiving: an enriching experience for families and residents in long-term care. *J Gerontol Nurs*. 34(7): pp.50-55.
Dew, Mary Amanda, Jean M. Goycoolea, Ronna C. Harris, Ann Lee, Rachelle Zomak, Jacqueline Dunbar-Jacob, Armando Rotondi, Bartley P. Griffith, and Robert L. Kormos., 2004. An internet-based intervention to improve psychosocial outcomes in heart transplant recipients and family caregivers: development and evaluation. *The Journal of Heart and Lung Transplantation*, 23(6), pp. 745-758.
Gustafson, D.H., McTavish, F.M., Stengle, W., Ballard, D., Hawkins, R., Shaw, B.R., Jones, E., Julèsberg, K., McDowell, H., Chen, W.C. and Volrathongchai, K., 2005. Use and impact of eHealth system by low-income women with breast cancer. *Journal of Health Communication*, 10(S1), pp.195-218.
Hill, W., Weinert, C. and Cudney, S., 2006. Influence of a computer intervention on the psychological status of chronically ill rural women: preliminary results. *Nursing Research*, 55(1), pp.34-42.
O'Connor, M.F., Arizmendi, B.J. and Kaszniak, A.W., 2014. Virtually supportive: a feasibility pilot study of an online support group for dementia caregivers in a 3D virtual environment. *Journal of Aging Studies*, 30, pp.87-93.
Savolainen, L., Hanson, E., Magnusson, L. and Gustavsson, T., 2008. An Internet-based videoconferencing system for supporting frail elderly people and their carers. *Journal of Telemedicine and Telecare*, 14(2), pp.79-82.
Schwindenhammer, T.M., 2013. *Videoconferencing Intervention for Depressive Symptoms and Loneliness in Nursing Home Elders*. Illinois State University.

[3] Two of the studies appear to be based on quantitative data from the same participants HILL, W., WEINERT, C. & CUDNEY, S. 2006. Influence of a computer intervention on the psychological status of chronically ill rural women: preliminary results. *Nursing research,* 55**,** 34, WEINERT, C., CUDNEY, S. & HILL, W. G. 2008. Rural women, technology, and self-management of chronic illness. *The Canadian journal of nursing research= Revue canadienne de recherche en sciences infirmieres,* 40**,** 114., although they are treated as distinct in the source review MORRIS, M. E., ADAIR, B., OZANNE, E., KUROWSKI, W., MILLER, K. J., PEARCE, A. J., SANTAMARIA, N., LONG, M., VENTURA, C. & SAID, C. M. 2014. Smart technologies to enhance social connectedness in older people who live at home. *Australasian journal on ageing,* 33**,** 142-152.

Torp, S., Hanson, E., Hauge, S., Ulstein, I. and Magnusson, L., 2008. A pilot study of how information and communication technology may contribute to health promotion among elderly spousal carers in Norway. *Health & Social Care in the Community*, 16(1), pp.75-85.
Tsai, H.H. and Tsai, Y.F., 2010. Older nursing home residents' experiences with videoconferencing to communicate with family members. *Journal of Clinical Nursing*, 19(11-12), pp.1538-1543.
Tsai, H.H. and Tsai, Y.F., 2011. Changes in depressive symptoms, social support, and loneliness over 1 year after a minimum 3-month videoconference program for older nursing home residents. *Journal of Medical Internet Research*, 13(4), p.e93.
Tsai, H.H., Tsai, Y.F., Wang, H.H., Chang, Y.C. and Chu, H.H., 2010. Videoconference program enhances social support, loneliness, and depressive status of elderly nursing home residents. *Aging and Mental Health*, 14(8), pp.947-954.
van der Heide, L.A., Willems, C.G., Spreeuwenberg, M.D., Rietman, J. and de Witte, L.P., 2012. Implementation of CareTV in care for the elderly: the effects on feelings of loneliness and safety and future challenges. *Technology and Disability*, 24(4), pp.283-291.
Weinert, C., Cudney, S., Comstock, B. and Bansal, A., 2011. Computer intervention impact on psychosocial adaptation of rural women with chronic conditions. *Nursing Research*, 60(2), pp.82-91.
Weinert, C., Cudney, S. and Hill, W.G., 2008. Rural women, technology, and self-management of chronic illness. *The Canadian Journal of Nursing Research*, 40(3), pp.114-134.

3.4.1 Aims

The reported aims of the primary studies were as follows:

- To evaluate the effect of an internet social networking intervention on temporal loneliness (Ballantyne et al., 2010).
- To determine if a computer-based intervention can change perceptions of social support (Barrera et al., 2002).
- To investigate the impact of a six-month web-based intervention on the psychosocial well-being of older adults with diabetes (Bond et al., 2010).
- To assess the impact of different models of telephone-based befriending services on older people's health and wellbeing (Cattan et al., 2011).
- To explore the role of videophone technology in enhancing the distant care-giving experience of, and communication between, residents of a long-term care facility and their family members (Demiris et al., 2008).
- To evaluate an internet-based psychosocial intervention for heart recipients and their carers (Dew et al., 2004).
- To examine the feasibility of reaching underserved women with breast cancer with an eHealth system, determining how they use the system and what impact it had on them (Gustafson et al., 2005).
- To examine the effects of a computer-delivered intervention on measures of psychosocial health in chronically ill rural women including social support, self-esteem, empowerment, self-efficacy, depression, loneliness, and stress (three studies) (Hill et al., 2006, Weinert et al., 2011, Weinert et al., 2008).
- To investigate the feasibility of using online virtual support groups for caregivers of persons with dementia (O'Connor et al., 2014).
- To evaluate an integrated web-based multi-media and video communication system (Savolainen et al., 2008).

- To determine if videoconferencing between nursing home elders and their families leads to a decrease in depressive symptoms and loneliness (Schwindenhammer, 2014).
- To explore family carers' ability to use an ICT-based intervention to increase knowledge, coping and informal support networks (Torp et al., 2008).
- To explore older nursing home residents' experiences of using videoconferencing to communicate with family members (Tsai and Tsai, 2010).
- To evaluate the long-term effectiveness of a videoconferencing intervention on improving nursing home residents' social support, loneliness and depressive status (two studies) (Tsai and Tsai, 2011, Tsai et al., 2010).
- Investigate whether Care TV is a valid instrument for older adults to engage in meaningful social contacts by a video connection to avoid loneliness (van der Heide et al., 2012).

3.4.2 Populations

The studies included a range of populations, conditions and settings. Three studies included home-dwelling older adults in Australia, Sweden and the UK; six were conducted in nursing homes in the Netherlands, Taiwan and the USA; two were conducted with caregivers of people living with dementia, or following a stroke in Norway and the USA; two were conducted with older adults with diabetes, living at home in the USA. All of these studies included participants aged between 50 and 95 years. Not all studies reported the age range, reporting the mean age and standard deviation instead. One of the above studies reported the age range as mid-50s to mid-90s (Cattan et al., 2011). In addition to these studies, there were four in which the age range dropped below 50 years. One study including women with breast cancer, living at home in the USA, included women with a mean age of 51.6 (SD 11.8). Three studies included women with various chronic illnesses, living at home in the USA, with mean ages of 51.8 (SD 2.17); 56.1 (SD 7.1); and with 65% of participants reported as over 50 years old. As the mean ages, or the majority of participants, were over 50 years, we included these studies in this synthesis.

3.4.3 Study designs and quality appraisal

We identified 16 different interventions within the 18 manuscripts, with two reported on both qualitatively and quantitatively. There were five qualitative studies, one mixed-methods, four quasi-experimental, three cohort, and five RCTs. As stated in section 3.2.3, not all of the included reviews included quality appraisals of the primary studies. As such, only two of our included primary studies had a specific rating. Torp et al. (2008) and Tsai et al. (2010) were deemed to be 'weak' and 'strong' respectively based on quality (EPHPP) scores in the review by Chen and Schulz (2016). In a review conducted by Morris et al. (2014), studies were rated using the Down & Black's checklist, but only the median score for all studies combined was reported and not for individual studies.

3.4.4 Interventions

The interventions reported in the 18 studies fell into five categories:

- **Supported videoconferencing to alleviate loneliness** (Savolainen et al., 2008, Tsai and Tsai, 2010, Schwindenhammer, 2014, Tsai and Tsai, 2011, Tsai et al., 2010).
- **Telephone befriending to reduce social isolation** (Cattan et al., 2011, Gustafson et al., 2005).

- **Online discussion groups/forums to reduce social isolation and/or loneliness, or to improve/maintain social connectedness** (Barrera et al., 2002, Bond et al., 2010, Dew et al., 2004, Gustafson et al., 2005, Hill et al., 2006, O'Connor et al., 2014, Torp et al., 2008, Weinert et al., 2011).
- **Supported use of social networking sites for mitigating social isolation and loneliness** (Ballantyne et al., 2010).
- **Multi-tool interventions (PC, training, messaging, chat groups) to reduce loneliness and/or social isolation, or increase social connectedness** (Hill et al., 2006, van der Heide et al., 2012, Weinert et al., 2011, Weinert et al., 2008).

3.4.5 Outcome measures

Six of the studies used qualitative methods to ascertain views on loneliness, social isolation, and social connections. Loneliness was measured by the UCLA Loneliness Scale (Russell et al., 1980) in six studies; by the de Jong Gierveld scale (De Jong-Gierveld and Kamphuls, 1985) in one study; and by an unspecified questionnaire in one study. Social support was measured by a variety of different tools: the Social Support Behavior Scale (Hsiung, 1999); a 20-item scale (Russell et al., 1980); the 15-item Personal Resource Questionnaire (PRQ) 2000 (Brandt and Weinert, 1981); the Interpersonal Support Evaluation List (ISEL) (Brookings and Bolton, 1988); the Diabetes Social Support Scale (Bond et al., 2010); and a bespoke six-item scale measuring women's perception of emotional and instrumental support.

3.5 Narrative synthesis of findings

3.5.1 Supported videoconferencing to alleviate loneliness

Supported video-communication interventions were regarded positively by older adults, with evidence of decreases in feelings of loneliness and increases in social support scores.

Bennett's (2015) review found, in the video-communication studies, that there were increased feelings of closeness and involvement between family members. Some older adults reported feeling less isolated and lonely, with significant reductions in feelings of loneliness found in four studies. Findings indicated that video-communication enhanced older adults' social interaction, with increases in measured social support. Whilst there was some anxiety around competence in using the technology, this review concluded that video-communication had a positive impact on older adults' social wellbeing. Within Bennett's review, Demiris et al. (2008) and Schwindenhammer (2013) both reported individual studies based in nursing homes in the USA. Demiris et al.'s qualitative study found that video-communication reduced feelings of loneliness, enabling people to feel more connected with their families. Similarly, Schwindenhammer's quantitative study demonstrated decreased levels of loneliness following videoconferencing with family members. Older adults were supported to make the calls in both studies.

Four of the five reviews (Beneitot-Montegut et al., 2015; Bennett, 2015; Chen & Schulz, 2016; Khosravi et al., 2016) included studies of supported videoconference interaction between nursing home residents and family members in Taiwan. These studies (Tsai and Tsai (2010); Tsai and Tsai (2011); Tsai et al (2010)) all reported on an intervention where residents were supported by a research assistant to engage in videoconferencing with their family members once a week, for at least 5 minutes, for three months. The qualitative study (Tsai and Tsai, 2010) found that the older adults valued the time that they spent with their family members, increasing their sense of connection. The two quantitative

studies (Tsai et al., 2010; Tsai and Tsai, 2011) found reduced feelings of loneliness at one week, three months and 12 months, although this achieved statistical significance in only one study[4](Tsai and Tsai, 2011). Emotional and appraisal social support scores were also higher in the intervention group than the control group at both one week, three months and 12 months.

In Chen and Schulz's (2016) review, two primary studies reported on the videoconferencing element of the ACTION service in Sweden and Norway. Participants in Salvolainen et al's (2008) qualitative study reported a positive impact on loneliness. Torp et al's (2008) mixed-methods pilot cohort study also found that the video phone was important for building and maintaining relationships. Both interventions included ongoing support to use the technology.

3.5.2 Telephone befriending to reduce social isolation

Telephone contact was only used in two primary studies. Qualitative findings showed reduced feelings of loneliness and social isolation. Older adults felt more connected to others and were more able to cope.

In their review on the effect of ICT intervention on social isolation, Chen & Schulz (2016) included a study on telephone befriending (Cattan et al., 2011); the only such study that we identified in our searches. This study reports on the *Call in Time* intervention, with qualitative findings from 40 participants. Telephone calls were made to older adults by volunteers, with a project co-ordinator managing the process. Findings included reduced feelings of social isolation, loneliness, depression and anxiety; improved state of mind, contentment with life, confidence level, and physical health (less pain). This study built on an earlier evaluation report that presented data used for the QCA (Cattan et al., 2008); this evaluation report was not directly included in any of the reviews, but quantitative data presented within this report suggested that participants had lower wellbeing and social support after the intervention, albeit with a number of caveats.

The only other included study to use a telephone was Gustafson et al. (2005), from the Morris et al. (2014) review, where one element of the intervention was to match up participants with peer advocates, who engaged in weekly phone calls. This was not a telephone befriending service, as the peer advocate had a different role to that of a befriender. Findings showed that, of those who used a peer advocate 77.3% felt somewhat or very much connected with their peer advocate, and 81.6% felt that the peer advocate helped them cope (somewhat or very much so) with their breast cancer. Perceived social support increased significantly over the 4 months, but the intervention included more elements than just telephone support (computer and internet training, discussion group, 'ask an expert' service and written guidelines).

Neither primary study looked at the impact of the intervention on those delivering it. The findings reported in Cattan et al. (2011) came exclusively from older recipients of telephone befriending. However, some of these participants did state that they wanted to become telephone befrienders themselves, to give something back. Gustafson et al. (2005) report that no outcome measures were collected on peer advocates, but did acknowledge the potential positive impact of taking on the role.

[4] It was also unclear whether the intracluster correlation had been accounted for in calculating measures of effect.

3.5.3 Online discussion groups/forums to reduce social isolation and/or loneliness, or to improve/maintain social connectedness

Online discussion groups and forums showed mixed results, with regard to loneliness and social isolation. The majority of studies showed increases in social support, but only two showed reductions in loneliness, with four studies not measuring loneliness at all.

The Khosravi et al. (2016) review found that health support chat rooms led to significant improvements in social support, but not in the level of loneliness. However, the 3D virtual environment, reported in O'Connor et al.'s (2014) primary study, where older adults were represented as avatars that could communicate with each other, resulted in lower levels of depression and loneliness. Both the Khosravi et al. (2016) review and the Morris et al. (2014) review included studies of synchronous and asynchronous communication: real-time chat discussions, instant peer-messaging, email contact with professionals, and discussion boards. Within these reviews, Gustafson et al. (2005) report on an integrated web-based programme, stating that the discussion group was the most extensively used service, with 79.65% of participants taking part. Results showed that perceived social support increased (p=0.000). The asynchronous chat room 'Koffee Klatch' in Hill et al.(2006)'s primary study provided a forum for women with chronic illnesses to share their feelings, concerns, life experiences and provide support to each other over 22 weeks, resulting in significant increases in social support, but not in loneliness, compared to the control group. The Sharing Circle in Weinert et al. (2011) provided the same opportunities, with the addition of discussion of self-study units and internet-based health information. This study saw statistically significant improvements in loneliness, but not in social support, compared to the control group.

In the Morris et al (2014) review, Barrera et al. (2002) and Bond et al (2010) both report on RCTs of internet-based discussion groups for people with diabetes. Both forums were monitored by health or research staff, with direct messaging also possible between the participants and the professionals. Both studies reported significant increases in social support. A similar design was implemented in Dew et al. (2004), which explored the development of social functioning through an intervention aimed at heart transplant recipients and their carers. Torp et al. (2008) reported on a mixed-methods pilot cohort study, which included professionally facilitated online peer discussions, alongside computer and internet training, videophone and one-to-one contact with health professionals. There were significant increases in scores with regards to contact with family and friends and a sense of social support from other people. Carers reported that using the videophone and discussion forum helped them to build social networks and friendships, as the connection felt more familiar when they could see each other and communicate regularly.

3.5.4 Supported use of social networking sites for mitigating social isolation and loneliness

Social networking sites have the potential to reduce loneliness in older adults, but the evidence here is weak. Perceived value and the strength of ties within a social networking site appeared to be issues for older adults.

In their review, Beneito-Montegut et al. (2018) were cautious about the effects of social networking sites (SNS) on social isolation. The differences in conceptualising social isolation made it difficult to compare studies and make robust conclusions. There was a suggestion that older adults were more interested in a smaller number of strong relationships mediated through the internet, than they were in a larger network with weak

ties. Similarly, in their review Khosravi et al. (2016) reported mixed results in their SNS studies, with both increases and decreases in social isolation and loneliness. They report that perceived value could have been an issue for older adults, which may have been more obvious through supported SNS interventions such as that reported by Ballentyne et al. (2010). The authors of this qualitative study found that the utilisation of a SNS has the potential to reduce loneliness in older people, as there were positive impacts on temporal loneliness (especially in the evening) and on connectedness.

3.5.5 Multi-tool interventions (PC, training, internet use, messaging, chat groups) to reduce loneliness and/or social isolation, or increase social connectedness

Multi-tool interventions included in this review demonstrated significant decreases in loneliness, but not always increases in social support. The nature and content of these interventions varied, so it is difficult to isolate the effective elements. The relationship between internet use and loneliness is complex, in part due to the different aspects of the internet that are accessed (entertainment, communication, information, finding new people (e.g. Facebook), or commercial purposes), and partly due to the different conceptualisations and measures of loneliness (Beneito-Montegut et al., 2018).

The Beneito-Montegut et al. (2018) review found that internet use appeared to be associated with higher satisfaction with the amount of contact with family and friends. Similarly, the Chen and Schulz (2016) review concluded that ICT usage among older adults positively impacted social support, social contacts and social networks positively, but not the number of confidants or social wellbeing. Fifteen of the 18 studies included in the Chen and Schulz (2016) review reported a significant reduction in loneliness through using ICT (including communication, gaming and virtual pets). However, different results were achieved depending on the conceptualisation of loneliness. Whilst social and family loneliness was reduced, reductions in romantic loneliness were not determined. The review authors suggest that older adults' use of ICT reduces their social isolation through the following mechanisms: connecting to the outside world, gaining social support, engaging in activities of interest, and boosting self-confidence. The findings suggest that older people can use ICT after tailored training.

The Bennett (2015) and Khosravi et al. (2016) reviews both included the study by van der Heide et al. (2012), which reports on the Care TV package for people receiving home care in The Netherlands. This video and voice network allowed clients to communicate 24 hours, seven days a week with a nurse practitioner. They received a 'Good Morning/Goodnight' call and could use the video facility to call family members. Average feelings of loneliness decreased substantially, with social and emotional loneliness showing pronounced decreases.

The Morris et al. (2014) review included seven web-based multi-component systems, which included information, intervention and communication programmes. Positive results included provision of health information, support groups, chat rooms or discussion boards. Three of the primary studies focused on web-based discussion groups in the Women to Women programme, with mixed results regarding levels of loneliness and social support. Weinert et al. (2011) report on an RCT of a web-based discussion groups, with a peer-led online support group and self-study units supported by an Advance Practice Nurse. Improvements were found in loneliness, but there was no significant difference in social support between the intervention and comparison groups, following the 11-week intervention. Weinert et al. (2008), found significant increases in both loneliness and

social support, compared to the control group, over the 22-week intervention. Hill et al. (2006), found statistically significant effect on both social support and loneliness after 22 weeks' participation.

3.6 Summary

- **Supported video-communication interventions** were regarded positively by older adults, with evidence of decreases in feelings of loneliness and increases in social support scores.
- **Telephone contact** was only used in two studies. Qualitative findings showed reduced feelings of loneliness and social isolation. Older adults felt more connected to others and were more able to cope.
- **Online discussion groups and forums** showed mixed results, with regard to loneliness and social isolation. The majority of studies showed increases in social support, but only two showed reductions in loneliness, with four studies not measuring loneliness at all.
- **Social networking sites** have the potential to reduce loneliness in older adults, but the evidence here is weak. Perceived value and the strength of ties within a social networking site appeared to be issues for older adults.
- **Multi-tool interventions** included in this review demonstrated significant decreases in loneliness, but not always increases in social support. The nature and content of these interventions varied, so it is difficult to isolate the effective elements.
- Concepts of loneliness and social isolation varies between studies, making comparisons and conclusions challenging.

3.7 Intervention Component Analysis and Qualitative Comparative Analysis

ICA was used to identify and extract informal evidence from triallists on the core processes undertaken during trials that may have led to a successful intervention. The results are integrated with QCA below, as well as being presented in appendix table 10. We undertook a rapid Qualitative Comparative Analysis (QCA) to synthesise data from a subset of primary studies.

While QCA is named as a qualitative technique, it involves numeric data and is an approach based on set-theory. QCA involves determining which sets studies belong to in terms of both 'condition sets' (i.e. belonging to a distinct set of studies distinguished by the presence or absence of different characteristics or processes) and 'outcome sets' (i.e. belonging to a group of studies differentiated by whether they are successful (having higher effect sizes) or unsuccessful (having lower effect sizes)). The goal of QCA is then to determine the strength of relationships between condition sets and outcome sets, and here we aim to identify which condition sets can be viewed as sub-sets of outcome sets, known as a sufficient relationship. A visualisation is provided in Figure 3, which indicates a 'sufficient relationship' in that studies that that allow participants to express themselves freely without self-consciousness are a subset of the successful outcome set.

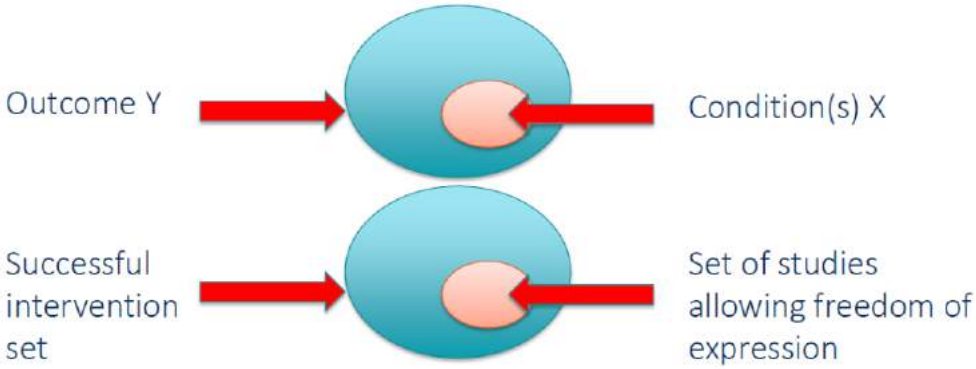

Figure 3: Illustration of subset relationship (sufficient relationship) underpinning the QCA in this review

QCA allows us to recognise that there may be different pathways to successful interventions and the goal of QCA is to identify the simplest expression of characteristics/processes that lead to effective interventions; to find the simplest expression we draw on Boolean minimisation. To undertake QCA, we first conducted Intervention Component Analysis (ICA) through inductively coding the nature of intervention features (i.e. components) and using trialists' informally reported experience-based evidence (e.g. evidence reported in introduction and/or discussion sections) (Sutcliffe et al., 2015).

3.7.1 Theory selection

A fundamental element of conducting QCA is the selection of an appropriate theory to base the analysis on, and to help identify suitable evidence to extract as part of the ICA. To understand which processes might be important to incorporate in interventions – regardless of specific mode of delivery (i.e. videoconferencing or internet chat group) - we drew on Robert Weiss's (1969) 'Fund of Sociability' theory[5] The theory was developed on the basis of empirical observations of individuals who had lost an important relationship or experienced a significant life course transition, but who also had the opportunity for 'unlimited sociability' (i.e. have the time available to invest in social relationships), and is intended to capture assumptions, content, and functions of social ties that can help to support developing social relationships. The theory specifies five characteristics of social interactions and relationships that are necessary for well-being and the avoidance of loneliness, plus an additional sixth that some people find important (Weiss, 1969) had supported the development of relationships with these . Table 4 outlines the six categories, their definitions and how we interpreted them in relation to the interventions in the QCA.

[5] This theory also served as the conceptual framework underpinning one of the included studies (Weinert et al., 2008)

Table 4: Six categories of the fund of sociability theory

Category	Definition in Weiss 1969	Application in QCA
1. **Intimacy *(which we describe as close relationships in our narrative)***	'*An effective emotional integration in which individuals can express their feelings freely and without self-consciousness*' (p.38)	Intervention supports participants to express feelings freely and without self-consciousness (e.g. opportunities for unstructured discussions with peers)
2. **Interaction**	'*Participants share concerns, either because of similar situations ("we are in the same boat") or because they are striving for similar objectives*' (p.39)	Target population has shared experience (e.g. being a carer, stroke survivor etc.) and shared characteristics (e.g. women only, people of similar age / SES etc.)
3. **Nurturance**	'*Opportunity for nurturant behavior … absence of this function may be signalled by a sense that one's life is unfulfilled, meaningless, and empty of purpose*' (p.39)	Intervention values / encourages participant sharing of experiences for others benefit (e.g. group discussions / bulletin boards invite participants to share experiences)
4. **Self-worth**	'*Relationships that attest to an individual's competence in some role*' p.39	Intervention enhances sense of competence by offering control over design / delivery (e.g. participants determine frequency of discussion groups / identify topics for discussion)
5. **Availability**	'*Assistance that is not limited in time and extent*' (p.40)	Intervention is available continuously and provides opportunities for asynchronous and 'real-time' interactions (e.g. website information resources (continuous), discussion board (asynchronous), videoconferencing / 'live-chat' (real-time))
6. **Support**	'*This function might be characterized as guidance, and may be provided by mental-health professionals such as social workers or psychiatrists or by ministers and priests, among others.*' (p.40)	Services include some form of pastoral care (e.g. light-touch oversight of a discussion forum by professionals or opportunities for participants to contact professionals for advice)

Our QCA built on the earlier descriptive and narrative synthesis, and addressed the question: 'Do the characteristics of social interactions and relationships stated in the fund of sociability theory explain differences between remotely delivered interventions found to be effective compared to those found to be ineffective?'

3.7.2 Selection of cases (studies) for the QCA

We focussed on studies that met our criteria for the QCA including that they (a) presented quantitative results, (b) were remotely delivered, (c) focussed on older people, and (d) actively sought to strengthen social relationships or prevent/offset loneliness. The included studies were Barrera et al. (2002), Bond et al. (2010), Dew et al. (2004), Gustafson et al. (2005), O'Connor et al. (2014), Schwindenhammer (2014), Tsai et al. (2010), Tsai and Tsai (2011), Torp et al. (2008), Weinert et al. (2011), Weinert et al. (2008); and two papers from the same study (Cattan et al. (2011), Cattan et al. (2008)). We determined that a study by Hill et al. (2006) may have contained some of the same participants as the later study by Weinert et al. (2008) and was not included. In addition,

we did not include a study by van der Heide et al. (2012) as the intervention was delivered alongside a number of other services, and we determined that the study was therefore conceptually distinct from the other studies included.

To gain familiarity with the studies and attempt to gain 'deep case knowledge', we started by reading and re-reading the studies. Other steps, for example contacting authors or 'sense checking' the interpretation of studies within the research team or with other external stakeholders, were not possible because of the rapid nature of the QCA. Henceforth, we frequently refer to studies as 'cases', in line with QCA terminology.

3.7.3 Developing a data table

For each case (study) we calculated an estimated effect size. Because of differences in measurement, most were based on information on social support, which we regarded as a proxy measure for social isolation. The exceptions were Schwindenhammer (2014) and O'Connor et al. (2014) where a measure of loneliness was the only suitable outcome available.

Effect sizes in evidence synthesis are usually associated with meta-analysis, although are used differently in QCA. In this case, the studies had different designs, and different ways of measuring the outcome, making an overarching meta-analysis of the 12 cases unsuitable. However, we did attempt to express the effect sizes in a common rubric where possible, e.g. prioritising post-test measures for studies that involved randomisation of participants or clusters (five studies), and change measures where these data were not available. We use the effect size differently within QCA as opposed to meta-analysis, and as a guide to allocating studies to successful (most effective) or unsuccessful (least effective) outcome sets, rather than to provide a pooled estimate of effect with precision. Using the effect size for indicative purposes, we grouped interventions into those that were 'successful' (four studies with effect sizes over 0.5), 'partially successful' (three studies with effect sizes between 0.2 and 0.5) and 'not successful' (five studies with effect sizes under 0.2 or suggested negative impacts) based on thresholds suggested by Cohen (2013) for interpreting effect sizes. For those studies with a comparator group (eight studies), effect sizes were calculated in the standard way (see Thomas et al., 2017); for those studies that employed a pre- and post- evaluation design an effect size was estimated based on changes in the pre- and post- individual scores divided by the standard deviation at pre-test (York, 2016, Masi et al., 2011); in some cases this involved using mean differences as proxy information.

For each condition (factors or antecedents that shape intervention outcomes) a coding scheme was developed to determine whether the processes observed in Table 4 (above) were present in the cases. The scheme and data table is presented in Appendix 3, with example information supporting each study presented (Table 11).

As we had a limited set of cases for the number of conditions, our analytical strategy involved first creating a 'truth table' based on six conditions, and then producing a reduced truth table and minimised solution (Kneale et al., 2019). A 'truth table' sorts cases according to the configuration of conditions they exhibit.

3.7.4 Truth table

Table 5 outlines the distributions of the cases across the different configurations of characteristics in what is known as a truth table. Each row in the table represents a 'condition set', that is a set of cases each sharing the same configuration of characteristics. For example, row A of Table 5 we see that there are three cases and each

of these cases addresses all six of categories of Fund of Sociability theory (denoted by the 1 in each condition column 1-6). Rows with a '1' in the outcome column are configurations that are viewed as triggering a successful intervention (i.e. the top four rows of table 5). Those with a '0' in the outcome column are viewed as triggering an unsuccessful (least effective) intervention. On the right side of the table is a column marked consistency; this indicates the strength to which studies that belong to the condition set are also a subset of the outcome set. A value of 1 indicates perfect consistency; all cases in the configuration are strong members of the condition set and the successful outcome set (a subset relationship, see Figure 3); and there is strong evidence that these intervention characteristics trigger successful outcomes. A value of 0 indicates perfect inconsistency and there is no evidence that these intervention characteristics trigger successful outcomes. Values in between indicate some degree of ambiguity, which was expected given that we used a "fuzzy-set coding scheme" which allowed studies to be partial members of sets (using a value of 0.85 to denote membership of the outcome set). The table shows four configurations supported by studies that are observed to trigger a successful outcome (Rows A-D). This includes a configuration supported by three cases that includes all of the conditions (Row A).

Table 5: Initial truth table

Configuration (1=Present; 0=Absent)	1. Intimacy	2. Interaction	3. Nurturance	4. Self-worth	5. Availability	6. Support	Outcome	Number of cases	Consistency	PRI (Proportional Reduction in Inconsistencv)
A	1	1	1	1	1	1	1	3	1	1
B	1	1	0	1	1	1	1	2	1	1
C	1	1	0	0	1	0	1	1	1	1
D	1	1	0	0	1	1	1	1	1	1
E	1	1	0	1	0	1	0	1	0.605	0.507
F	0	0	0	0	0	0	0	3	0	0
G	1	0	0	0	0	0	0	1	0	0

PRI: PRI is indicative of how distinct a subset configuration is of the outcome compared to negation of the outcome

We also deduced that there were a number of potential configurations of intervention characteristics that were not supported by data (known as logical remainders). Although QCA can allow for some configurations without studies, in Table 5, out of a possible 64 combination of intervention characteristics, we observed just seven of these. This led to an issue of limited diversity, where the data are too sparsely distributed leading to too many logical remainders. To address this concern, and based on the results in Table 5 we formed a reduced truth table (Table 6, below) in which we removed two conditions. Although we noted that both nurturance and availability of support were conditions only observed in successful intervention studies, they did not appear to be as critical to outcome success as the other conditions, appearing in fewer studies. Our new truth table thus contained four conditions (intimacy, interaction, support and availability) with five of

a possible 16 configurations represented. Two configurations are observed as triggering a successful outcome; in one, supported by five studies, all four conditions are present; in the second, supported by one study, three of four conditions are present, with limitations in the availability of support identified.

Table 6: Reduced truth table

Configuration (1=Present; 0=Absent)	Intimacy	Interaction	Support	Availability	Outcome	Number of studies	Consistency	PRI (Proportional Reduction in Inconsistency)
A	1	1	1	1	1	6	1	1
B	1	1	1	0	1	1	1	1
C	1	1	0	1	0	1	0.605	0.507
D	0	0	0	0	0	3	0	0
E	1	0	0	0	0	1	0	0

3.7.5 Boolean minimisation and formation of a solution

We applied Boolean Minimisation to obtain the simplest expression of those conditions (intervention processes) that were associated with triggering a successful intervention. We developed a complex solution based on the observed data only, and found that those interventions that ensured the following processes took place were those in the successful outcome set:

INTIMACY and INTERACTION and SUPPORT

Information from logical remainders can be used to simplify the solution and checking the impact of incorporating these is critical in assessing the quality of the solution. We incorporated these logical remainders to develop two further solutions (known as a parsimonious and intermediate solution), although incorporating logical remainders did not help to simplify the solution above. Our model and details of its fit are presented below (table 7). The high consistency value for the solution suggests that when this configuration of conditions is observed in an intervention, it is generally sufficient to trigger a successful intervention (i.e. a substantial change in social support). The coverage statistic suggests that the majority of successful outcomes are supported or explained by this configuration of study characteristics.

Table 7: Solution

	Solution Consistency	PRI (Proportional Reduction in Inconsistency)	Solution coverage	Studies
INTIMACY*INTERACTION*SUPPORT	0.936	0.921	0.829	(Barrera et al., 2002, Bond et al., 2010, Dew et al., 2004, Gustafson et al., 2005, O'Connor et al., 2014, Torp et al.,

2008, Weinert et al., 2008)

3.7.5.1 Additional technical quality checks

We also undertook quality checks to understand whether our solution, or the assumptions we made in its derivation, could also predict unsuccessful outcome, and found little evidence that this was a possibility. We also explored whether focussing only on the 10 studies that measured social support would change our interpretation (and omitting the two studies that only had measures of loneliness), and found little evidence that this would influence the model. Similarly, focussing only on studies that had a comparison group showed a similar pattern descriptively[6]. We also examined whether alternative effect sizes that could have been calculated from the studies would alter the solution. In only one case did we find evidence that this could change our interpretation, with one study changing from the unsuccessful to successful group when the mean change between groups rather than post-test data were used (Schwindenhammer, 2014). Even with this change, further analysis using the alternative effect size was found to lead to the same solution (with similar consistency but a small drop in coverage to 0.71), although further exploration of this study is warranted to provide a qualitative explanation for this potential inconsistency. The studies located in Corry et al. (2019), Elvish et al. (2013), Hopwood et al. (2018), Lins et al. (2014) also provide a potential further pool of studies upon which to test this model in the future.

3.7.6 Interpretation of the solution

Those interventions that (i) supported participants to form 'intimate' relationships and express their feelings freely without self-consciousness between peers; and (ii) ensured that there were shared characteristics between participants and their peers (beyond a single experience, and beyond geography alone); and (iii) included some form of pastoral care or support (e.g. light-touch oversight of a discussion forum by professionals or opportunities for participants to contact professionals for advice) were those that were in the successful outcome set. This configuration explained the majority of the successful outcomes we observed.

The available qualitative data collected within the studies were also illustrative of these processes and supported the solution that was formed (see table 11 for full information). For example, a participant in Weinert et al. (2008) illustrated the value of the intervention in forming 'intimate' relationships characterised by mutuality:

"There is no outside support. All we can do, since I think we're in WTW [Women to Women] because we are isolated, is support each other… and I think we do a fantastic job of that! …and try to remain strong and focused, personally."

Participants in Torp et al. (2008, p80) emphasised the value of shared characteristics and experiences the helped to sustain relationships:

"It's easier to be together with others in the same situation. We've so much more to talk about. . . . Others don't have the same understanding. . . ."

Similarly, the ethos described in Weinert et al. (2008, p7) that the 'forum was for and by the women, and although it was monitored by a research team member' was emblematic

[6] However, running a model based on only 8 studies with 4 conditions would not be appropriate.

of a process by which triallists facilitated the development of social relationships between participants, but offered light-touch support if this was needed (see further data extracted as part of the ICA in table 11).

Taken together, albeit with some caveats, these characteristics can form a set of design principles for future interventions that are delivered remotely which aim to increase support available to older adults and offset the risks of social isolation and loneliness. The interventions that were not in the successful outcome set did not provide evidence that all three processes had been part of the interventions, and some indicated that processes to the contrary had taken place.

3.7.7 Necessary conditions

The QCA analysis considered the presence of sufficient conditions – those conditions sets considered to be sub-sets of outcome sets[7]. However, some conditions may be considered necessary conditions to running any intervention (where the outcome set can be considered a sub-set of a condition set). In this case we would think of necessary conditions as being those intervention characteristics and processes that must be in place for all successful interventions to run. These might be elements such as having the right equipment or training in place. Identifying these 'necessary conditions' is not usually a focus of QCA in systematic reviews. Here we did not purposively explore these necessary conditions as the studies were heterogeneous in approach to remote delivery (i.e. they included telephone interventions, internet chat rooms etc.). While we did not purposively explore these, we can theorise what form some of these necessary conditions could have taken.

A number of studies described measures for training volunteers. For example, Gustafson et al. (2005) described how the researchers "held a day-long training seminar for all peer advocates, reviewing the overall goals of the project; the expectations and responsibilities of the peer advocate, new CHESS services, basic breast cancer information, and active listening skills" (p199).

Among those interventions that rely on online interaction, participants in studies were often already familiar with technology. For example, O'Connor et al. (2014) discussed how all included participants had in-home access to an internet connected computer, suggesting pre-existing digital skills, and described how 'each participant was given time to practice logging in, navigating in the environment, and conversing with the study coordinator in the [intervention] virtual environment prior to the first session' (p89). Where participants were expected to engage with new technology, some studies described how assistance was on hand to help participants navigate new technology. This may have been welcome, although our QCA results above also emphasise that there is a balance to be struck in how this assistance is provided. Some interventions that focussed on supported videoconferencing suggested that the assistance provided to support the technology, such as assistants being in earshot of conversations, may have been intrusive and had stopped the formation of close (intimate) relationships being formed.

From a design perspective, a necessary component of successful interventions may have been to keep group numbers low to reflect some of the restrictions in social interactions that occur remotely (and particularly the restrictions on non-verbal communication) as

[7] Although there was some overlap with necessary conditions - those conditions present in all successful interventions.

well as technical difficulties in working with larger groups remotely. O'Connor et al. (2014) described how 'groups were kept small (n = 3–4) because we predicted that the groups would be smoother if there were fewer technical difficulties to overcome (due to a smaller number of group members)' (p89).

3.7.8 Summary of QCA

- The QCA suggested that studies with the following characteristics are effective in developing social support:
    1. **Supporting development of close ('intimate') relationships:** Intervention supports participants to express feelings freely and without self-consciousness (e.g. opportunities for unstructured discussions with peers)
    2. **Supporting interactions through ensuring participants share experiences/characteristics:** Target population has shared experience (e.g. being a carer, stroke survivor etc.) and shared characteristics (e.g. women only, people of similar age / SES etc.)
    3. **Support interactions through pastoral guidance**, while maintaining the principles above (1 and 2): Services include some form of pastoral care (e.g. light-touch oversight of a discussion forum by professionals or opportunities for participants to contact professionals for advice)
- Other processes around ensuring that participants feel that their participation is beneficial for others as well as themselves, ensuring participants have a stake in the intervention design or the way they can participate, and ensuring that participants can take place through different channels and temporalities (i.e. in real time and asynchronous) may also be important as they were more frequently observed in successful interventions. However, successful interventions tended to ensure that all three processes above took place in the intervention. Taken together, these can serve as design principles for future interventions. Unsuccessful interventions either did not ensure all three processes took place simultaneously, or were ones where none of the processes took place.
- Future work could involve examining the validity of these characteristics in a broader pool of studies, for example those located in Corry et al. (2019), Elvish et al. (2013), Hopwood et al. (2018), Lins et al. (2014).
- Overall, the findings from the QCA were congruent with a longstanding framework for understanding the properties of social relationships that can offset loneliness and social isolation (Weiss, 1969). The findings suggest that studies that do not pay adequate attention to the characteristics of social interactions and relationships that are necessary for well-being and the avoidance of loneliness, are unlikely to substantially reduce social isolation (through fostering social support) or reduce loneliness.

3.8 Evidence map

3.8.1 Review-level map

An interactive evidence map was created to represent the breath and quality of the evidence (see snapshot in Figure 4). Columns represent the type of intervention mode included in the review (e.g. videoconferencing etc.) and rows represent the population. The circles are scaled according to the number of supporting studies (larger circles reflect a larger number of studies) and coloured according to quality (red indicates low quality and green high quality).

The map clearly highlights that most of the evidence was drawn from low quality reviews, with only two (focussed on caregivers) deemed to be high quality. Links to the maps are provided on the EPPI-Centre website (TBC)[8].

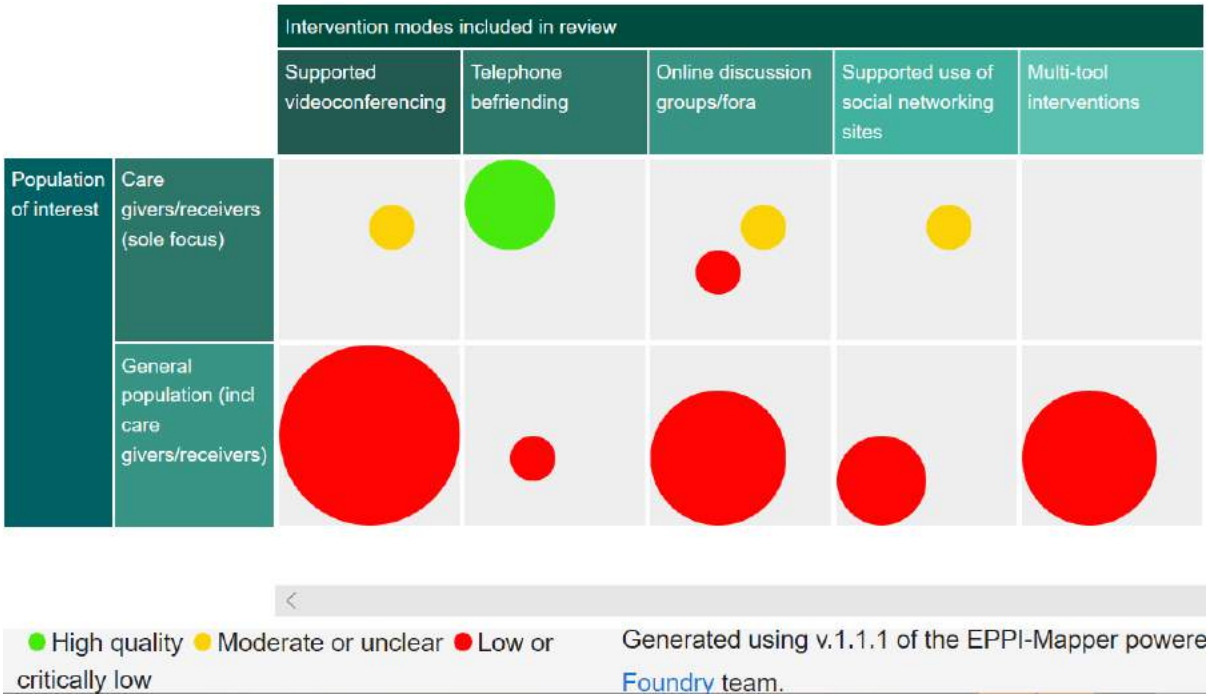

Figure 4: Snapshot from review-level map of evidence

3.8.2 Study-level map

Figure 5 presents information on study-level evidence, with columns representing the population of the intervention, and rows the intervention mode (e.g. videoconferencing etc); the circles are scaled according to the number of supporting studies and coloured according to the number of participants included in the evaluation, with red indicating a very small number (1-4 participants) and green a higher number (50 and over).

Looking at the final two columns, the map shows clearly a paucity of larger studies evaluating interventions among older people who are not distinguished by a particular chronic illness, and who are not caregivers.

[8] NB: the same review can be displayed in different cells if its focus includes multiple intervention modes

Figure 5: Snapshot from study-level map of evidence

An interactive version will be hosted on the EPPI-Centre website.

4 Summary and discussion

4.1 Summary of findings

In this rapid review of reviews, we have shown that:

- **Supported video-communication interventions** are regarded positively by older adults and can have positive effects on loneliness and social support.
- **Telephone befriending** has not been widely researched, but qualitative studies suggest improvements in loneliness and social isolation.
- **Online discussion groups and forums** are less clear with mixed results, with increases in social support, but less evidence for improvements in loneliness.
- The evidence for **social networking sites** is weak.
- **Multi-tool interventions** show decreases in loneliness, but not always increases in social support. These interventions vary greatly, so it is difficult to isolate the effective elements.
- Concepts of loneliness and social isolation vary, making comparisons and conclusions challenging.

The QCA has shown that following characteristics are present in effective interventions:

- **Supporting development of intimate relationships.**
- **Supporting interactions through ensuring participants share experiences/characteristics.**
- **Support interactions through pastoral guidance.**

4.2 Discussion

4.2.1 Gaps in the evidence

Despite our extensive searches, we found only one study of telephone befriending (Cattan et al., 2011), included within a single systematic review. This was also the one of the few studies that made use of volunteers. There was no information provided about the training and support provided to the volunteers, as the focus was on the experience of older adults receiving the service. Similarly, we found little information about training and support provided to staff members supporting the interventions. Information, communication, support, moderation and mediation was provided to older adults by research staff and health professionals (nurses, psychologists, advance nurse practitioners)within the primary studies, but there was little detail about *how* staff were trained or supported to provide these. Emotional and practical support for people delivering befriending or psychological support to others is likely to be important for managing their own psychological wellbeing, as well as for delivering a high-quality experience for others. Guidelines published elsewhere suggest volunteers or staff members should receive high-quality training and regular supervision to be competent (NICE, 2009).

Four studies reported that the contact facilitated by the various technologies engendered feelings of safety and comfort (Barrera et al., 2002; Cattan et al., 2011; Salvolainen et al., 2008; Tsai & Tsai, 2011). However, none of the studies addressed safeguarding issues explicitly. There was no consideration of risk of harm to participants, or concerns about technology being used to exploit vulnerable older adults. Similarly, the evidence did not allow us to examine issues around implementation in detail because of the heterogeneity in the approach of the interventions. This meant we were not able to fully assess the necessary pre-conditions (e.g. volunteer or participant training, technical support etc.) to deliver the interventions. Neither were we able to synthesise evidence on issues around dosage or intensity of the interventions, beyond the findings of the QCA. These suggested that interventions needed to be of a level of intensity such that they supported the development of close relationships, and that a key role of volunteers/staff was to offer pastoral support, but not at the expense of forming close relationships with other participants.

Most of the included primary studies involved some form of new technology, with just two involving an intervention delivered through (traditional) telephone. No study examined an intervention delivered through a smartphone, and this remains a gap in our evidence.Similarly, our inclusion criteria could have theoretically allowed other forms of remotely delivered interventions to be included, such as letter writing to have been included, although no such study was identified. These forms of interventions could be purposively considered in future reviews, with a recent intervention involving cross-generational letter writing suggestive of positive impacts for older and younger people alike (Binnie, 2019). More broadly, there may be scope in the future for inter or cross-generational interventions that can help to provide both befriending, and technological support, while maintaining the principles outlined earlier.

We found few studies reporting on low intensity psychological interventions, which could be due to our focus on loneliness and/or social isolation as outcomes of interest. In the broader literature, whilst some studies have demonstrated positive impacts on depression, wellbeing and general mental health of delivering therapies through remote means (Kaonga and Morgan, 2019), several of these interventions may not specifically address loneliness and are not targeted at older adults (Burholt et al., 2020).

4.2.2 Empowering and supporting older adults involved in remote interventions

Overall, the results suggest that older adults can be empowered to support each other through online discussions and forums. We found reviews containing several studies with peer support, provided through synchronous and asynchronous messaging, chat rooms and discussion forums. This challenges the assumption that older adults must always be on the receiving end of an intervention to address social isolation and loneliness. When we moved to study-level synthesis, we also found that studies that enabled older people to feel that their contributions could improve the outcomes of others (i.e. improved levels of self-worth (Barrera et al., 2002, Bond et al., 2010, Gustafson et al., 2005, Torp et al., 2008, Weinert et al., 2008), tended to be successful interventions[9] As the mobilisation of thousands of volunteers takes place to support older people who are currently shielding in the COVID-19 pandemic, recognising that older people can be both providers and recipients of support simultaneously is likely to be an important principle to adhere to in the design of activities.

We included studies that used video-communication, as long as older adults were supported to participate. We regarded these interventions as different to simply providing equipment and training for older adults to use the technology independently. The included studies identified some feelings of apprehension, lack of digital skills, and fear of getting things wrong among older adult participants using internet-mediated communication. The support offered by research staff, or health professionals meant that problems in using the technology could be dealt with quickly, reducing the likelihood that the technology would be abandoned. Similarly, the findings of the Technology in Later Life (TILL) project (not included in the review) identified the need for older adults to be given time and support to use new technologies. The authors advocate the provision of age-appropriate training and support strategies for older adults to use existing and new technologies, acknowledging the fact that one-off training is often not sufficient, and that back-up support is needed, should something go wrong (Marston et al., 2019). They also identified the importance of high-speed internet connections for the smooth running of internet-mediated communications, something which the UK Government has already recognised as essential through its Universal Service Obligation. However, while the provision of support is important, particularly with technical aspects, the QCA emphasises that there is a fine balance in the provision of this support. Support – technical and pastoral – is a requirement for many of the successful interventions in this review, but this was provided at a level that did not undermine people's capacity to form close relationships with others and did not disempower older people from recognising the importance of their own contribution and capacity to provide emotional and social support to others.

A small number of barriers were reported by participants accessing technology-based interventions from their own homes. Only three participants across all of the primary studies dropped out because they found the technology too difficult to use, or had out of

[9] A condition reflecting self-worth was not used in the final QCA models because of the small number of studies

date software. Many participants were first time users of computers and, with support, were able to participate fully in the interventions. O'Connor et al. (2014) reported the establishment of a helpdesk during the intervention, as a response to the unexpected technical difficulties that they suggest will always occur in technology-based interventions. Some motivating factors could be identified in just three of the primary studies, with feelings of temporal loneliness, the appreciation of mutual support, connection with others in a similar situation, and a sense of belonging compelling participants to engage with the technologies.

4.2.3 New technologies and remote interventions

Recent years have been witness to the proliferation of new technology to support communication. The included video-communication studies found positive effects on both loneliness and social isolation, with qualitative findings including increases in feelings of connection with family members, feeling more a part of their lives. A recent study by Burholt et al. (2020) (not included in the present review) used CFAS Wales data demonstrated a link between family proximity and loneliness and isolation; the further away an older adult's family lived, and the less frequent face-to-face contact, the greater the feelings of loneliness and isolation. Their study demonstrated that contact with family through technology-mediated communication may have influenced social isolation, but not loneliness. The subjective nature of loneliness may be at play here, as the discrepancy between desired contact and available contact may still exist. Therefore it should be noted that the provision of technology-mediated communication on its own is not sufficient. Training, ongoing support, and clear expectations must be addressed.

Loneliness and isolation are extremely complex phenomena (Hayanga et al., 2020), and require a deep understanding and deliberative treatment that was beyond the remit of this rapid review. The risk of running unsuccessful interventions may be higher than many triallists appear to recognise, and a failure to ensure that the processes identified here are designed into interventions may have adverse impacts for older people, for example in heightening their feelings of alienation (Wong et al., 2017). In our QCA results we outlined a number of potential design principles for future interventions. These were drawn from the studies themselves, but also crucially a theory that supported us in thinking through what we meant by social isolation and loneliness; what social relationships are and can look like; what function social relationships hold; and how these elements could be supported in a trial setting. These principles involved (i) supporting the development of 'intimate' relationships; (ii) supporting interactions through ensuring participants share experiences/characteristics; and (iii) supporting interactions through pastoral guidance. We also noted the potential importance of ensuring empowerment and participant direction in the intervention and their participation. The findings from this review do not lead us to recommend particular modes of delivering befriending, social support, or low-intensity psychological interventions (e.g. videoconferencing, telephone calls, chat rooms or forums), but they do suggest that these principles should be incorporated into the delivery of an intervention.

4.3 Salience of findings

As a 'sense check' of our findings, we will discuss the feasibility of including these principles in the delivery of befriending, social support, or low-intensity psychological interventions, with our networks (e.g. Age UK Network Partners across England). This report will be updated, following this exercise.

4.4 Strengths and limitations

The strengths of this rapid review include the transparent and robust approach to searches, data extraction, review quality appraisal and analysis, ensured through pre-publication of a protocol on the EPPI-Centre website. Despite the very rapid nature of this review process, we have conducted the review according to systematic review methodology (Gough et al., 2017). Screening, data extraction and quality appraisal were completed in duplicate, with disagreements resolved by discussion and consensus between three researchers (DK, EB & PH); QCA data extraction was undertaken by three researchers (DK, KS & BH). The wide methodological and subject expertise of the review team, based across three units and five academic institutions, also contributed to the strength of this work.

A further strength was the diversity of synthesis approaches conducted, including narrative synthesis both at a review and study level, Qualitative Component Analysis, Intervention Component Analysis, and the presentation of the included reviews and studies in the EPPI-Mapper format.

Searching for systematic reviews means that we may have missed some more recent primary studies in this area, but it ensured that our review was achievable within the four-week timeframe required for a timely response during the COVID-19 crisis. We applied the AMSTAR2 quality appraisal tool to the included reviews, although the reviews included in the synthesis were found to have a low quality rating; a possible explanation may be that the tool itself may not be intended for the types of review included in the current study which included a range of study designs. In addition, we did not conduct any quality assessment of the primary studies that we looked at in more detail. Some of these had been assessed by the review authors, but many had not. There were very few identifiably robust primary studies that met our inclusion criteria. Only one primary study was identified by review authors as 'strong', with others rated as 'weak' or with no quality appraisal at all. The poor, or lack of, quality rating for many of the included studies means that findings should be considered with caution. In addition, few of the studies considered potential adverse impacts of the interventions. However, this is the case for many reviews in this research area and is not unique to our rapid review.

Owing to the rapid nature of this review, we focussed on a sub-set of reviews addressing interventions to mitigate loneliness or social isolation on the general older adult population, rather than including the additional reviews focussing on caregivers, identified through the searches. Given more time, and if deemed useful, these reviews could be considered, and their findings incorporated into a larger review.

Other limitations included our treatment of primary studies in the QCA, where the neither the precision of the effect size, study design, or quality were included in the model or the allocation into different outcome sets. Studies with weaker designs, and effect sizes derived from these, were treated in the same way as those with more robust designs. Although this is not uncommon in QCA practice, further synthesis could be conducted with a more nuanced approach to allocating studies into un/successful sets in the future, although was beyond the remit of the current four-week review.

4.5 Further research

We recommend that further research be undertaken investigating (i) telephone befriending through a systematic review; (ii) the robustness of the QCA synthesis through

the addition of further evidence; (iii) the provision of training and support for remote interventions; and (iv) greater investigation of the comparative effectiveness of different intervention modes

We were surprised by the identification of only one systematic review including a telephone befriending intervention. Given the UK Government's interest in encouraging volunteers to make phone calls to physically isolating and shielding older adults, under the 'stay at home' guidance, we suggest that a systematic review of telephone befriending interventions is conducted, to identify evidence to inform policy in this area. A review by (Sharma et al., 2018) suggested that a large portion of such interventions may be found in grey literature; although we did not include this review because of a lack of transparency on the origins of evidence and detailed evidence tables. None of the primary studies included in the systematic reviews drew on grey literature, indicating an obvious omission. In addition, in the current context of the COVID-19 pandemic, a number of befriending interventions are being conducted by a variety of organisations, and there is scope to incorporate learning from these in future systematic reviews in this area.

There is scope for exploring the robustness of the findings here through incorporating further evidence. A starting point could be the incorporation of evidence from those studies identified in the current review that were focussed on caregivers. These were not incorporated here because of the rapid nature of the work. These could allow for testing whether the processes identified through the QCA as important to incorporate within intervention design are generalisable to a different pool of studies that have the same aim of improving social isolation and loneliness.

As the training and support components of the technology-mediated interventions were unreported in the reviews and studies that we synthesised, there is a need to search for these elsewhere. We suggest that evaluations of existing telephone befriending and psychosocial support services could act as a starting point (e.g. *Call in Time; The Silver Line*). Additional valuable information could be obtained through contact with voluntary sector and NHS organisations delivering befriending, peer support and low-intensity psychological interventions to see if they will share details of their training and support programmes. A review of these training and support components could add valuable insight for policy makers and service providers to ensure that volunteers are well trained, empowered and supported in delivering interventions adhering to the principles outlined earlier.

Finally, while the findings from this review allow us to theorise on the processes that are more likely to lead to successful interventions, a more robust approach is needed in order to attempt to understand whether different intervention modes are more effective than others. Although we believe all of the intervention modes in scope here have the capacity to include the processes found to lead to more successful interventions (supporting the development of intimate relationships; supporting interactions through ensuring participants share experiences/characteristics; provide pastoral guidance), a more encompassing piece of research is needed in order to identify which mode is most effective, or has the greatest potential, for changing outcomes. A starting point to this may be in understanding how interventions could better incorporate these processes in their design, building on the planned 'sense checking' that will be conducted.

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Conflicts of interest

None

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Appendix 1 – Search history

Example search history - Medline search history

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to April 23, 2020>

No of records: 814

1 ((("old" or "older" or "oldest" or "frail" or "elder" or senior or ageing or aging or aged) adj3 (adult* or user* or person or persons or people* or community or communities or consumer* or clients* or population* or resident or residents or individual or individuals or citizen* or men or mens or "men's" or women*)) or ("age in place" or "ageing in place" or "aging in place" or "mature adult*" or "later life" or "late life" or "middle age" or "middle aged" or "mid life" or midlife or "middle life" or "elderly" or geriatric* or "seniors" or pensioner* or "old age" or "old aged" or "elders" or "oldest old" or "menopause" or "menopausal" or "retirement" or "retired" or "senior age" or "senior aged" or (pension* adj1 age*) or "active aging" or "active ageing" or "aged care" or ("care home*" adj2 (resident or residents")))).jw,ti,ab,kf,kw,bt. (742709)

2 "health services for the aged"/ or Geriatrics/ or Geriatric Nursing/ or Geriatric Psychiatry/ or Retirement/ or "Aged, 80 and over"/ or Aged/ or "frail elderly"/ or Aging/ or "Middle Aged"/ (5156903)

3 1 or 2 (5384479)

4 (computer* or digital* or virtual* or online* or "web-based" or "web based" or (electronic* not ("electronic database*" or "electronic search*" or "electronic health record*")) or ("web" or "web site*" or "remote*" or website* or phone* or telephone* or Internet* or technolog* or videoconferenc* or "video-conferenc*" or "video conference*") or (video adj3 communicat*) or ("e-mail*" or email* or smartphones* or "smart phone*" or "mobile app*" or "instant messag*" or (messag* adj1 service*) or chatroom* or "chat room*" or "telehealth" or telemed* or telecare or telecaring or mhealth or ehealth or "tele health" or "tele med*" or "tele care" or "tele caring" or "m health" or "mobile health" or "e health" or "live chat*" or "chat interface*" or "chat forum*" or "chat site" or "chat sites" or "chatsite*" or "tele therap*" or "teletherapy" or "etherapy" or "e therapy" or "CDs" or "compact disk*" or "compact disc*" or "CD-ROM*" or "CD ROM*" or Telegroup* or "tele group*" or Chatrooms) or (audio adj3 (CBT or support or therapy or "cognitive behavio*" or guide* or message* or intervention*)) or ("e-support" or "e support" or "e intervention" or "e interventions" or bibliotherapy or "biblio-therapy" or "biblio therapy" or "e counselling" or "e-counselling" or "e counseling" or "e-counseling" or "e CBT*" or "e-CBT*" or eCBT* or ICBT or "ILR") or (distanc* adj3 befriend*) or helpline* or "help line*" or "help-line*" or "support line*" or "texting" or "text messag*" or SMS or "short message service*" or "short messaging service*" or "self help" or "self care" or "self guid*" or "self-help" or "self-care" or "self-guid*").jw,ti,ab,kf,kw,bt. or (app or apps).ti. (2077286)

5 self care/ or Self-Help Devices/ or "Self-help groups"/ or Computer Terminals/ or Microcomputers/ or minicomputers/ or Computers, Handheld/ or Smartphone/ or Telemedicine/ or Telerehabilitation/ or Mobile applications/ or Text messaging/ or Cell phone/ or Therapy, computer assisted/ or Information technology/ or Internet/ or speech recognition software/ or Computer simulation/ or virtual reality/ or User-computer interface/ or Social networking/ or online social networking/ or "cell phone use"/ or Technology transfer/ or internet access/ or Virtual reality exposure therapy/ or social

media/ or computer communication networks/ or Wireless technology/ or telecommunications/ or Telemetry/ or Remote Sensing Technology/ or medical informatics applications/ or Telephone/ or Answering Services/ or Bibliotherapy/ or "Psychosocial Support Systems"/ (424288)

6 4 or 5 (2297531)

7 "social support"/ or "social environment"/ or "social networking"/ or "social isolation"/ or "social distance"/ or "social identification"/ or "social marginalization"/ or "Interpersonal Relations"/ or Loneliness/ or "mental health"/ or "Social Capital"/ or "Health status"/ (295346)

8 (connectedness or "well-being" or wellbeing or "well being" or "social isolation" or loneliness or belonging or "social inclusion" or "social connection" or "social contact" or "social distance" or "social capital" or "social participation" or "social outcomes" or "social exclusion" or "social contact" or "social contacts" or (connections adj2 others) or (connections adj2 maintain*) or "social connectivity" or "social relationships").jw,ti,ab,kf,kw,bt. (208378)

9 7 or 8 (471854)

10 ((("synthesis" or "systematic" or "umbrella" or "overview") and ("evidence" or "research" or "review*")) or ("review*" and (integrat* or critical* or "mapping" or "comprehensive" or "evidence" or "research" or "literature")) or ((summary or analysis or review) and (articles and reviews))).ti. or ((systematic adj2 review*) or ("meta-analysis" or "Review articles" or "systematic review*" or "Overview of reviews" or "Review of Reviews") or ("data synthesis" or "evidence synthesis" or "metasynthesis" or "meta-synthesis" or "narrative synthesis" or "qualitative synthesis" or "quantitative synthesis" or "realist synthesis" or "research synthesis" or "synthesis of evidence" or "thematic synthesis" or "systematic map*" or "metaanaly*" or "meta-analy*" or "systematic overview*" or "systematic review*" or "systematically review*" or "bibliographic search" or "database search" or "electronic search" or "handsearch*" or "hand search*" or "keyword search" or "literature search" or "search term*" or "literature review" or "overview of reviews" or "review literature" or (review* adj2 literature) or "reviews studies" or "scoping stud*" or "overview study" or "meta-ethnograph*" or "meta-epidemiological" or "data extraction" or "meta-regression" or "narrative review" or "art review" or "scoping review" or "iterative review" or "meta -summary" or "metareview" or "meta-review")).jw,ti,ab,kf,kw,bt. (567552)

11 ("systematic review" or "meta-analysis").pt. (187732)

12 10 or 11 (577729)

13 3 and 6 and 9 and 12 (835)

14 limit 13 to english (814)

Appendix 2 – Further details of inclusion/exclusion criteria

EXCLUDE 1 – Duplicate Study

EXCLUDE 2 - Study design (a) - Study is not a systematic review. It does not satisfy at least four out of the five criteria (i) Were inclusion/exclusion criteria reported?; (ii) Was the search adequate?; (iii) Were the included studies synthesised?; (iv) Was the quality of the included studies assessed?; (v) Are sufficient details about the individual included studies presented?

EXCLUDE 3 – Study design (b) Study is another review of reviews or umbrella review; Coded separately to check studies later

EXCLUDE 4 - Not older people. Exclude on age group (not focussed on older people aged 50+)

EXCLUDE 5 – Focus/outcomes - There is insufficient focus on ameliorating social isolation and/or loneliness as a an intervention objective AND/OR no measurement of social isolation/loneliness (or proxy measures) as an outcome

EXCLUDE 6 - Intervention mode (not remote): Study does not involve intervention delivered remotely or intervention involves physical contact. Remote interventions include traditional telephone-based interventions, as well as smartphone and online interventions. General systematic reviews on loneliness/isolation (e.g. (Cattan et al., 2005)) were coded using this exclusion criteria for checking further later.

EXCLUDE 7 - Intervention approach (not befriending, social support or low Intensity psychosocial interventions). Reviews on ICT interventions (e.g. (Choi et al., 2012)) were coded using this exclusion criteria for checking further later.

EXCLUDE 8 – Reviews focussed on interventions taking place in hospital settings

EXCLUDE 9 - Language (not in English)

INCLUDE

Appendix 3 – Further details of included reviews and primary studies

Table 8 Data extraction tables for included reviews and primary studies

Included review	Type of review and study numbers	Review focus / aim	AMSTAR2 rating	Studies included in our review	Population and setting	Study design and intervention	Measure of loneliness/social isolation	Outcomes	Quality tool used in review (rating)
Beneito-Montagut, R., Cassián-Yde, N. and Begueria, A., 2018. What do we know about the relationship between internet-mediated interaction and social isolation and loneliness in later life? *Quality in Ageing and Older Adults*. 19(1) pp.14-30.	Literature review that meets the definition of a systematic review. 25 studies	To review previous research that investigates the relationship between internet use for communication and social isolation and loneliness, including its effects on social relationships in later life.	Critically Low	1. Ballantyne, A., Trenwith, L., Zubrinich, S. and Corlis, M., 2010. 'I feel less lonely': what older people say about participating in a social networking website. *Quality in Ageing and Older Adults*, 11(3), pp.25-35.	Participants: n=4 older adults, age range 69-85, 3 males, 1 female Living at home, Australia	Pilot project: to evaluate use of social network site (SNS) *About My Age*. One-on-one tutoring in how to use the social networking site, supported throughout the intervention by project team member.	Qualitative: Connectedness (proxy for isolation)	The utilisation of a SNS has the potential to reduce loneliness in older people. Positive effects of SNS on temporal loneliness (especially in the evening) and connectedness.	None
				2. Tsai, H.H. and Tsai, Y.F., 2011. Changes in depressive symptoms, social support, and loneliness over 1 year after a minimum 3-month videoconference program for older nursing home residents. *Journal of Medical Internet Research*, 13(4), p.e93.	Participants: n=90 older adults, age over 60 yrs Experimental (n=40; females=22) Control (n=50; females=30) Nursing home residents, Taiwan	Quasi-experimental: Supported video-conferencing intervention. Experimental group received at least 5 minutes/week for 3 months of video-conference interaction with their family members in addition to usual family visits. Videoconferencing supported by trained research assistant. Comparison group received regular family visits only.	Loneliness (UCLA Loneliness Scale)	Alleviated perceived loneliness at 3, 6, and 12m after the intervention. Experimental group had significantly lower mean loneliness and depressive status scores at 3m (-5.40, P < .001; -2.64, P < .001, respectively), 6m (-6.47, P < .001; -4.33, P < .001), and 12m (-6.27, P = .001; -4.40, P < .001) compared with baseline than those in the comparison group. Positive effects of support over time. Experimental group had significantly lower mean change in instrumental social support scores at 6m (-0.42, P = .03) and 12m (-0.41, P = .03), and higher mean change in emotional social support at 3m (0.74, P < .001) and 12m (0.61, P = .02), and in appraisal support at 3m (0.74, P = .001) No significant differences between experimental and control group regarding informational social support.	None

Included review	Type of review and study numbers	Review focus / aim	AMSTAR2 rating	Studies included in our review	Population and setting	Study design, intervention, comparison	Measure of loneliness/social isolation	Outcomes	Quality tool used in review (rating)
Bennett, N., 2015. The Impact of Video-Communication on Older Adults' Psychological Well-Being: A Mixed Methods Study (Doctoral dissertation, University of Essex).	Systematic review 10 studies	To answer what impact video-communication has on older adults' existing relationships and their psychological well-being, when it is used to communicate with friends and relatives.	Critically Low	1. Demiris, G., Oliver, D. R. P., Hensel, B., Dickey, G., Rantz, M., & Skubic, M. (2008). Use of videophones for distant caregiving: an enriching experience for families and residents in long-term care. *Journal of Gerontological Nursing*, *34*(7), 50-55.	Participants: n=4 older adults, age 65+. Nursing home residents, USA	Qualitative: Supported videophone intervention. Both residents and family members were asked to conduct a videocall at least once/week (or more if they chose to do so) and complete a form after each videocall to document its technical quality. Participants supported by long-term care facility staff to use videophone.	Qualitative: Thematic synthesis	Themes reported included; participants being included into family interactions and feeling part of the family; participants valuing seeing the other person's facial expressions; video-communication reduced feelings of loneliness; video found better than the telephone for emotional conversations; and concerns with using the technology.	None
				2. Schwindenhammer, T.M., 2013. *Videoconferencing Intervention for Depressive Symptoms and Loneliness in Nursing Home Elders*. Illinois State University.	Participants: n=80 older adults, age 65+ Intervention condition: n=40, mean age 85.42 (5.88). Control condition: n=40, mean age 86.82 (5.28). Nursing home residents, USA	Quasi-experimental within-between repeated measures: Supported video-conferencing intervention. Experimental group received Skype sessions with their family; Ten Skype sessions over a 14-week period, 10-30 minutes each time. Supported by researcher. Control group had regular care.	UCLA Loneliness Scale	The results indicate the intervention group felt a significantly decreased level of loneliness after videoconferencing with family members than before, while the control group did not significantly change their loneliness level from pre-intervention to post-intervention.	None
				3. Tsai, H.H. and Tsai, Y.F., 2010. Older nursing home residents' experiences with videoconferencing to communicate with family members. *Journal of Clinical Nursing*, 19(11-12), pp.1538-1543.	Participants: n=34 older adults, age range=60-95. Nursing home residents, Taiwan	Qualitative: Supported video-conferencing intervention. Videoconference programme once/week for three months. The contact family member was the resident's spouse, child or grandchild. The software at the facilities was either MSN or SKYPE, using a large laptop. Residents were helped to use technology by a trained research assistant, who spent at least five minutes/week with residents at the appointment time .	Qualitative: Thematic synthesis	Themes included: enriched life, second-best option for visiting, life adjustments and true picture of family life.	None

				4. Tsai, H.H. and Tsai, Y.F., 2011. **DUPLICATE (See Beneito-Montegut)**				None
				5. Tsai, H.H., Tsai, Y.F., Wang, H.H., Chang, Y.C. and Chu, H.H., 2010. Videoconference program enhances social support, loneliness, and depressive status of elderly nursing home residents. *Aging and Mental Health*, 14(8), pp.947-954.	Participants: n=57 older adults, (experimental group, n= 24) Mean age = 78 and control group, n = 33; Mean age = 74) Nursing home residents, Taiwan	Quasi-experimental: Supported video-conferencing intervention. Experimental group received at least 5 minutes/week for 3 months of video-conference interaction with their family members in addition to usual family visits. Videoconferencing was supported by a trained research assistant. Comparison group received regular family visits.	Depressive symptoms, loneliness and social support (Social support behavior scale (Hsiung, 1999)), via self-report questionnaires, administered at baseline, three, six and twelve months.	From baseline, compared to the control groups, video-communication significantly reduced feelings of loneliness at one week (β = -1.21, *P*= .002) and three months (β = -2.84, *P*= .003), and depressive status at three months. From baseline scores, changes in emotional social support scores at one week and three months and appraisal support scores at one week and three months were found to be significantly higher in the experimental groups compared to the changes in the control groups. Subjects in the experimental group had significantly higher mean emotional and appraisal social support scores at one week (β = .61, *p*< .001) and three months (β = .68, *P*< .001), after baseline than those in the control group.	
				6. van der Heide, L.A., Willems, C.G., Spreeuwenberg, M.D., Rietman, J. and de Witte, L.P., 2012. Implementation of CareTV in care for the elderly: the effects on feelings of loneliness and safety and future challenges. *Technology and Disability*, 24(4), pp.283-291.	Participants: n=130 older adults with no prior experience of video communication. mean age=73.2 Living in the community, accessing homecare, The Netherlands.	Pre-post intervention study (non-randomised): Care TV - video/voice network package. (24/7 communication facility with a nurse practitioner). CareTV applications are (1) Alarm Service; (2) Care Service; (3) Good morning/good evening service; (4) Welfare and housing; and (5) Family Contact.	Loneliness scale (Jong Gierveld & Kamphuis 1985). Clients' experiences were evaluated in open questions in the survey.	Average feeling of loneliness at group level decreased significantly (p<0.001) from 5.97 (sd 2.77) to 4.02 (sd 3.91) between the start and end of the study on a scale from 0 till 11. Social loneliness (5-items) as well as emotional loneliness (6-items) showed significant decreases.	

Included review	Type of review and study numbers	Review focus / aim	AMSTAR2 rating	Studies included in our review	Population and setting	Study design, intervention, comparison	Measure of loneliness/social isolation	Outcomes	Quality tool used in review (rating)
Chen, Y.R.R. and Schulz, P.J., 2016. The effect of information communication technology interventions on reducing social isolation in the elderly: a systematic review. *Journal of Medical Internet Research*, 18(1), p.e18.	Systematic review 25 studies	Explore the effects of ICT interventions on reduced social isolation of older people	Critically Low	1. Cattan, M., Kime, N. and Bagnall, A.M., 2011. The use of telephone befriending in low level support for socially isolated older people–an evaluation. *Health & Social Care in the Community*, 19(2), pp.198-206.	Participants: n=40 vulnerable, isolated, and/or lonely, age range = mid 50s – early 90s. Mostly living at home, UK.	In-depth interviews: Telephone befriending intervention, *Call in Time*. Telephone befriending	Qualitative.	Reduction of social isolation, loneliness, depression, and anxiety; improved state of mind, contentment with life, confidence level, and physical health (less pain).	Effective Public Health Practice Project (EPHPP): N/A
				2. Savolainen, L., Hanson, E., Magnusson, L. and Gustavsson, T., 2008. An Internet-based videoconferencing system for supporting frail elderly people and their carers. *Journal of Telemedicine and Telecare*, 14(2), pp.79-82.	Participants: n=8 older adults with frailty. age range= mid 50s – early 90s. Living at home, Sweden	In-depth interviews: Videoconferencing in the ACTION project (ICT to support frail older people and their family carer) Videoconferencing with family or professional carers.	Qualitative.	Seven out of the eight participants reported a positive impact on loneliness.	EPHPP: N/A
				3. Torp, S., Hanson, E., Hauge, S., Ulstein, I. and Magnusson, L., 2008. A pilot study of how information and communication technology may contribute to health promotion among elderly spousal carers in Norway. *Health & Social Care in the Community*, 16(1), pp.75-85.	Participants: n=19 carers of people with stroke or dementia. Mean age 73 (57-85), M11, F8 Living at home, Norway.	Pilot cohort study without control group (mixed-methods): ICT- and web-based ACTION service. Received broadband connected PC, 9 hours training over 3 weeks; connection to online discussion with peers; videophone for peer communication and contact with health personnel. Peer support facilitated by qualified nurses.	Social contacts measured by the Family and Friendship Contacts Scale Social support was measured with a 20-item scale developed by Russel *et al.* (1980). Focus Groups conducted.	Positive and significant change in scores with regards to contact with family and friends (P = 0.036) and a sense of social support from other persons (P = 0.010). Carers explained that the frequent contact they had via the videophone and discussion forum in-between the monthly meetings was important to build social networks and friendships.	EPHPP: Weak
				4. Tsai, H.H., Tsai, Y.F., Wang, H.H., Chang, Y.C. and Chu, H.H., 2010. **DUPLICATE (See Bennett)**					EPHPP: Strong

Included review	Type of review and study numbers	Review focus / aim	AMSTAR2 rating	Studies included in our review	Population and setting	Study design, intervention, comparison	Measure of loneliness/social isolation	Outcomes	Quality tool used in review (rating)
Khosravi, P., Rezvani, A. and Wiewiora, A., 2016. The impact of technology on older adults' social isolation. *Computers in Human Behavior*, 63, pp.594-603.	Systematic review	Identify ICTs that are designed to help seniors reduce their social isolation and loneliness, and assess the effectiveness of this technologies in supporting seniors' wellbeing 34 studies	Critically Low	1. Ballantyne, A., Trenwith, L., Zubrinich, S. and Corlis, M., 2010. **DUPLICATE (See Beneitot-Montegut)**					None
				2. Hill, W., Weinert, C. and Cudney, S., 2006. Influence of a computer intervention on the psychological status of chronically ill rural women: preliminary results. *Nursing Research*, 55(1), pp.34-42.	Participants: n=100 women with various chronic illnesses. Intervention: n=61; Control n=59; Age 30-69 (65% > 50yrs). Living at home, USA	RCT: Online self-help support group (Women to Women Program). 22 weeks participation in an online, asynchronous, peer-led support group and health teaching units. WebCT (2005) platform used to deliver the intervention and was available 24/7, allowing women to participate at any convenient time. Access to 'Koffee Klatch', an asynchronous chat room in which they exchanged feelings, expressed concerns, provided support, and shared life experiences. Access to each other and research team via email. Peer support and expert facilitated chat room: 'Health Roundtable'. Details of comparison arm not provided.	Social support: 15 item Personal Resource Questionnaire (PRQ) 2000 Loneliness: UCLA Loneliness Scale	Statistically significant effects on social support (p=0.38) but not on loneliness (p=.206).	None
				3. O'Connor, M.F., Arizmendi, B.J. and Kaszniak, A.W., 2014. Virtually supportive: a feasibility pilot study of an online support group for dementia caregivers in a 3D virtual environment. *Journal of Aging Studies*, 30, pp.87-93.	Participants: n=7 Dementia caregivers, age range=54-70 Living at home, USA	Pre-post intervention: 3D virtual environment. Participants interacted using avatars and real time chat in virtual environment (Second Life platform) in an 8-week support group.	UCLA Loneliness Scale	Lower levels of depression and loneliness across participants.	None
				4. Tsai, H.H. and Tsai, Y.F., 2011. **DUPLICATE (See Beneito-Montegut)**					None
				5. van der Heide, L.A., Willems, C.G., Spreeuwenberg, M.D., Rietman, J. and de Witte, L.P., 2012. **DUPLICATE (See Bennett)**					None

Included review	Type of review and study numbers	Review focus / aim	AMSTAR2 rating	Studies included in our review	Population and setting	Study design, intervention, comparison	Measure of loneliness/social isolation	Outcomes	Quality tool used in review (rating)
Morris, M.E., Adair, B., Ozanne, E., Kurowski, W., Miller, K.J., Pearce, A.J., Santamaria, N., Long, M., Ventura, C. and Said, C.M., 2014. Smart technologies to enhance social connectedness in older people who live at home. *Australasian Journal on Ageing*, 33(3), pp.142-152.	Systematic Review	To conduct a systematic review of studies that assessed the effectiveness of smart technologies in improving or maintaining the social connectedness of older adults who live at home. 18 studies	Low	1. Barrera, M., Glasgow, R.E., McKay, H.G., Boles, S.M. and Feil, E.G., 2002. Do Internet-based support interventions change perceptions of social support?: An experimental trial of approaches for supporting diabetes self-management. *American Journal of Community Psychology*, 30(5), pp.637-654.	Participants: n=160 people with type 2 diabetes. Mean age 59.3 (9.4). M75, F85. Living at home, USA	4 Group RCT: 1) Information only; 2) Personal Coach only; 3) Social Support only; 4) Personal Coach and Social Support. Internet-based support group - peer-directed (professionally supported) forum. Real time live chat discussions. Research staff monitored the forum and introduced topics for discussion.	Interpersonal Support Evaluation List (ISEL)	After 3m, individuals who participated in Internet- based social support interventions significantly increased their perceived availability of social support, relative to participants who only had computer access to information about diabetes. Effects found for general perceptions of support as well as with a measure of support that was designed specifically for individuals who participated in a computer-mediated intervention. Intervention effects f = .27 for the ISEL items.	Downs and Black checklist Not reported for individual studoes. Range 13-22 (median 18.5). Max score = 27.
				2. Bond, G.E., Burr, R.L., Wolf, F.M. and Feldt, K., 2010. The effects of a web-based intervention on psychosocial well-being among adults aged 60 and older with diabetes. *The Diabetes Educator*, 36(3), pp.446-456.	Participants: n=62 people with diabetes. Mean age Int: 66.2 (5.7), Control: 68.2 (6.2); M34, F28. Living at home, USA	RCT: Web-based interactive intervention. Monitored self-management by nurse; weekly online educational discussion group for peer support; peer email and instant messaging. Interaction between the study nurse and the intervention participants by synchronous (instant messaging and chat) and asynchronous communication (email and a bulletin board). Study nurse, social worker and psychologist moderated sessions. Control received standard diabetes care.	Diabetes-related social support was assessed using the Diabetes Social Support Scale.	Participants who received the Web intervention improved their depression, quality of life, self-efficacy, and social support ratings, compared with the control group (p=0.001).	
				3. Dew, Mary Amanda, Jean M. Goycoolea, Ronna C. Harris, Ann Lee, Rachelle Zomak, Jacqueline Dunbar-Jacob, Armando Rotondi, Bartley	Participants: n=64 heart transplant receipients and 60 care givers. Age: No data	Matched controlled cohort study: multifaceted web-based intervention. Stress and medical regimen management workshops; monitored discussion groups;	Sub-scale reported on Quality of Life (QoL) reflecting social functioning	QOL in social functioning improved significantly.	

				P. Griffith, and Robert L. Kormos. "An internet-based intervention to improve psychosocial outcomes in heart transplant recipients and family caregivers: development and evaluation." *The Journal of heart and lung transplantation* 23, no. 6 (2004): 745-758.	Gender: 46% female Living at home, USA	access to electronic communication with health professionals. Comparison groups of 40 patients and their caregivers who received only usual care were similarly assessed	(ability to interact with others and engage in social activities)		
				4. Gustafson, D.H., McTavish, F.M., Stengle, W., Ballard, D., Hawkins, R., Shaw, B.R., Jones, E., Julèsberg, K., McDowell, H., Chen, W.C. and Volrathongchai, K., 2005. Use and impact of eHealth system by low-income women with breast cancer. *Journal of Health Communication*, 10(S1), pp.195-218.	Participants: n=229 women with breast cancer. Mean age 51.6 (11.8). Living at home, USA	Cohort study: Integrated web-based programme. Participants taught how to use computer, internet and CHESS system (home based, to improve QoL), including participating in a discussion group and Ask an Expert service. Written guidelines provided. Peer advocates matched to participants to make weekly phone calls to participants. Comparison group taken from separate recently completed study.	Six-item social support scale for assessing women's perception of emotional and instrumental support.	The discussion group was the most extensively used service (79.65% participants used, with average time of 664 minutes over 4 months). Perceived social support (p=0.000). Of those who used a peer advocate 77.3% felt somewhat or very much connected with their peer advocate, and 81.6% felt that the peer advocate helped them cope (some- what or very much so) with their breast cancer.	
				5. Hill, W., Weinert, C. and Cudney, S., 2006. **DUPLICATE (See Khosravi)**					
				6. Torp, S., Hanson, E., Hauge, S., Ulstein, I. and Magnusson, L., 2008. **DUPLICATE (See Chen & Schulz)**					
				7. Weinert, C., Cudney, S. and Hill, W.G., 2008. Rural women, technology, and self-management of chronic illness. *The Canadian Journal of Nursing Research*, 40(3), pp.114-134.	Participants: n=233 women with various chronic illnesses. Mean age 51.8 (2.17). Living at home, USA	RCT: Web-based 22 week intervention programme (Women to Women Program). Peer-led virtual support group, and self-study web skills. Online, asynchronous, peer-led support group (Koffee Klatch) and health teaching units, prepared by the research team, supplemented by asynchronous, expert-facilitated discussions (Health Roundtable). Comparison group received regular care.	Loneliness: UCLA Loneliness Scale. Social support: Personal Resource Questionnaire 2000	Participants who had access to the online discussion boards showed a significant increase in self-efficacy (P = .04) and social support (P = .03) compared to the control groups who had no intervention.	

				8. Weinert, C., Cudney, S., Comstock, B. and Bansal, A., 2011. Computer intervention impact on psychosocial adaptation of rural women with chronic conditions. *Nursing Research*, 60(2), pp.82-91.	Participants: n=309 women with various chronic illnesses. Mean age 55.5. Intervention: 56.1 (7.7), control 55 (9.1). Living at home, USA	RCT: Web-based 11-week intervention (Women to Women Program) 24-hour access to (a) peer-led virtual support group (asynchronous forum: Sharing Circle, to exchange feelings and life experiences, give and receive support, discuss issues related to the self-study health teaching units, and share health information) and (b) a series of self-study health teaching units focused on Web skills and the five skills of self-management. Monitored by advance practice nurse. Two comparator arms: Less-intense intervention group (self-study health units), and regular care.	Loneliness: UCLA Loneliness Scale. Social support: Personal Resource Questionnaire 2000	Self-esteem (P = .018), acceptance (P = .001), depression (P = .010), stress (P = .005) and loneliness (P = .040) were improved in the intervention group compared to the control group. No statistically significant differences were seen between the two groups in social support (P = .097).	

Appendix 4 – Additional tables for QCA

Table 8: Data table for QCA

Study	Effect Size Estimate	Effect Size Set	Intimacy	Interaction	Control	Reassurance	Support	Availability
Barrera	0.530	1	1	0.66	0.66	1	1	1
Bond	0.634	1	1	1	0.33	1	0.66	1
Gustafson	0.619	1	1	1	0.33	1	0.66	0.66
Tsai 2010[10]	0.036	0	0.33	0	0	0	0.33	0
Tsai 2011[11]	0.051	0	0.33	0	0	0	0.33	0
Weinert 2008[12]	0.314	0.66	1	1	0.66	1	1	0.66
Weinert 2011	0.131	0	1	1	0.33	1	0	0.66
Schwindenhammer[13]	-0.098	0	0.33	0	0	0	0.33	0
Dew[14]	0.287	0.66	0.66	0.66	0.33	0	1	0.66
Torp[15]	0.552	1	1	1	1	1	1	1
Cattan	-0.687	0	0.66	0.33	0	0	0	0
O'Connor[16]	0.375	0.66	1	1	0.33	0.33	0.66	0.33

See also notes in methodology for further explanation

[10] Effect size based on post-test measurement and total social support at 3 months
[11] Effect size based on post-test measurement
[12] SD estimated from Weinert 2011, equal sample sizes assumed
[13] Effect size based on post-test measurement
[14] Note – effect size based on pre-post results for heart transplant recipients who received the intervention
[15] SD estimated from baseline value
[16] Mean and SD estimated from chart, error bars assumed to be based on SD (estimate of 12)

Table 9: Coding scheme for QCA

Intimacy	Interaction	Control	Reassurance	Support	Availability
1= Evidence that intervention created environments for free expression; 0.66=Evidence that potential for creating environments for free expression not realised 0.33=Focus only on privacy of technology or setting 0=Not mentioned	1=Common bond of shared experience (e.g. caregiving)plus additional characteristics; 0.66=Common bond of shared experience or characteristics; 0.33 =Little connection beyond superficial characteristics (e.g. age) 0=Not mentioned	1=Full control over direction of intervention and their experience in hands of participants; 0.66 = options for participants to communicate through chosen channel (formal and informal; different channels); 0.33= limited options for participants to choose how to engage 0 = No adaptation or tailoring to suit participants described	1=Participants encouraged to share experience and contribution valued equally with that of professionals 0.66=sharing is promoted/ valued 0.33=opportunities for sharing of participant expertise possible, but not described 0=Participants are recipients of support not providers	1 = responsive safety net available around to support participation 0.66 = professional facilitate in active role in activities 0.33= professional support for technical aspects only 0=No support described to support participation	1=Both real-time and asynchronous participation supported 0.66= Either real-time and asynchronous participation supported 0.33= Either real-time and asynchronous participation supported with limitations 0=No evidence around availability of asynchronous and/or real-time participation

Table 10: Full data and example evidence for studies included in QCA

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) | Mid blue = mostly meets (.66) | Light blue = partially meets (.33) | White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
Barerra et al. (2002) '*To determine if a computer-based intervention was successful in changing participants' perceptions of social support.*' (p.641)	**Participants:** n = 160 **Focus:** Diabetes patients **Country:** USA **Age:** mean 59 **Sex:** mixed **Design:** Controlled trial **Estimated effect size:** 0.530 **Outcome set:** Successful	'Participants encouraged to express their concerns, successes and frustrations with their day-to-day coping with diabetes' (p.644)	**Shared experience:** diabetes **Shared characteristics:** age	'Activities that provided participants with opportunities to exchange diabetes-related information, coping strategies, and emotional support.' (p.644)	'The main activity area, the Diabetes Support Conference, was a peer-directed (but professionally monitored) forum' (p.644)	**Continuous:** computer access to an extensive number of articles **Real-time:** Live 'chat' sessions **Asynchronous:** Discussion forum	'Periodically, the research staff introduced specific diabetes-related topics to stimulate peer group discussion.' (p.643)
Bond et al. (2010) '*To investigate the impact of a 6-month Web-based intervention on the psychosocial well-being of older*	**Participants:** n = 62 **Focus:** Diabetes patients **Country:** USA **Age:** mean 67 **Sex:** Mixed	'Participants had access to one another through e-mail and instant messaging … interactions were participant	**Shared experience:** diabetes **Shared characteristics:** 'mainly Caucasian, well educated, and earned an	'Weekly online educational discussion group treatment … to promote peer support and social interaction through sharing of each person's	'Formal weekly discussion group delivered by principal investigator … developed using resources available from National Institute	**Continuous:** Study Web site **Real-time:** 'Participants could have real-time conversations	'Interaction between the study nurse and the intervention participants using both synchronous communication (instant

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) | Mid blue = mostly meets (.66) | Light blue = partially meets (.33) | White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
adults with diabetes.' (p.446)	**Design:** Randomized controlled trial **Estimated effect size:** 0.634 **Outcome set:** Successful	generated and not moderated by any study personnel.' (p.448)	annual income greater than $40 000.'	personal experiences in dealing with their diabetes.' (p.448)	of Health, American Diabetes Association, and the Joslin Center.' (p.448)	when online and logged in' **Asynchronous:** e-mail / instant messaging	messaging and chat) and asynchronous communication (e-mail and a bulletin board).' (p.448)
Cattan et al. (2008) '*To investigate the direct impact of low level support on older people who are vulnerable, isolated or lonely using the telephone as a specific tool of befriending.*' (p.6)	**Participants:** n = 40 **Focus:** Older people **Country:** UK **Age:** n/s **Sex:** Mixed **Design:** Pre-post **Estimated effect size:** -0.687 **Outcome set:** Not successful	Unstructured phone conversations – but not with peers.	**Shared experience**: No peer-to-peer interaction. **Shared characteristics:** No peer-to-peer interaction.	No peer-to-peer interaction.	No – phone calls from befriender to participant only.	**Continuous:** No. **Real-time:** Yes. **Asynchronous:** No.	Volunteer befrienders only – unclear if trained 'eight telephone befriending schemes functioning within a variety of different parameters were included in the evaluation' (p.6)

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) | Mid blue = mostly meets (.66) | Light blue = partially meets (.33) | White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
Dew et al. (2004) *'[To] conduct the first empirical evaluation of an internet-based psychosocial intervention for heart recipients and their families.'* (p.745)	**Participants:** n = 60 **Focus:** Heart transplant recipients / carers **Country:** USA **Age:** Mostly over 55 years **Sex:** Mixed **Design:** Controlled trial **Estimated effect size:** 0.287 **Outcome set:** Partially successful	'Focus groups indicated that caregivers felt better able to voice their concerns in a forum separate from the patients … groups were monitored to ensure comments were suitable and appropriate.' (p.748)	**Shared experience:** Heart recipients / carers **Shared characteristics:** Heart recipients mostly male / carers mostly female – from Pittsburgh region	Discussion groups "bulletin boards" are only small component of overall intervention much more focus on skills and education (e.g. 'ask an expert', 'skills workshops', 'healthy living tips')- no mention of encouragement to share experiences.	'The groups were designed as "bulletin boards," with threaded comments, so that users could read and post comments at their own convenience.' (p748)	**Continuous:** Web-site **Real-time:** None **Asynchronous:** 'Ask an expert' + peer discussion forum	'Ask an Expert: This module provided an opportunity to consult the transplant team about non-emergency health-care issues.' (p.748)
Gustafson et al. (2005) *'To examine the feasibility of reaching underserved women with breast*	**Participants:** n = 280 **Focus:** Breast cancer patients **Country:** USA **Age:** Mean 52 **Sex:** Female	'Personal Stories … real-life text and video accounts from other participants.'	**Shared experience:** Breast cancer **Shared characteristics:** 'Low-income women in rural	'Sharing experiences with others in similar situations provide emotional and practical support, and also	Interactive design enables 'user control' and 'allows for patients facing divergent situation-movement states	**Continuous:** Instant library, video gallery **Real-time:** Peer advocate phone calls (i.e. not with peers)	Peer interactions facilitated by professionals indicating active, not pastoral oversight.

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) | Mid blue = mostly meets (.66) | Light blue = partially meets (.33) | White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
cancer with an eHealth system.' (p.198)	**Design:** Controlled trial **Estimated effect size:** 0.619 **Outcome set:** Successful	'Discussion Groups … facilitated bulletin boards for small groups of patients and families.' (p.198)	Wisconsin and Detroit, Michigan'	can buffer emotional distress.' (p.198)	to create useful individual meaning and response.' (p.198)	**Asynchronous:** bulletin board	Elements of other support also provided by lay advocates '[Peer advocates] helped patients via telephone and a private e-mail system added to CHESS called ''My Friend.''' (p.199)
O'Connor et al. (2014) '*The present study investigated the feasibility of using online virtual support groups for caregivers of persons with dementia.*' (p.89)	**Participants:** n = 10 **Focus:** Dementia carers **Country:** USA **Age:** Mean 61, range 54-70 **Sex:** Female **Design:** Pre-post **Estimated effect size:** 0.375	'Groups were driven primarily by participant discussion, with some direction and information provided by the psychologist.' (p.90)	**Shared experience:** Carers for dementia **Shared characteristics:** Older women from the greater Tucson and outlying regions.	Not explicitly encouraged / valued, however 'Participants commented on general supportiveness of the group e.g., "Hearing from others who have similar experiences" (p.91)	Some indication that participant voices were prioritised but unclear if this was above and beyond usual practice within a discussion group: 'Groups were driven primarily by participant discussion, with some direction	**Continuous:** No **Real-time:** Yes **Asynchronous:** No 'Each group convened weekly for 1 h, for eight weeks' (p.89)	Staff available but not clear if pastoral care 'Each group … included a psychologist (M-F.O.) and a project coordinator (a clinical psychology graduate student; B.A.).' (p.89)

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) | Mid blue = mostly meets (.66) | Light blue = partially meets (.33) | White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
	Outcome set: Partially successful				and information provided by the psychologist.' (p90)		
Schwindenhammer (2014) 'A video-conferencing intervention was conducted using Skype to reconnect nursing home elders to their family and friends as a means of decreasing depressive symptoms and loneliness.' (p.1)	**Participants:** n = 80 **Focus:** Nursing home elders **Country:** USA **Age:** Range 71-97 **Sex:** Mixed **Design:** Controlled trial **Estimated effect size:** -0.0976 **Outcome set:** Not successful	'The coinvestigator stood outside the door while the elder was conversing with their friend/ family member to allow for a private conversation.' (p.36)	**Shared experience:** With families / friends rather than peers **Shared characteristics:** With families / friends rather than peers	No peer-to-peer interaction.	No - 'Each week the co-investigator required both the elder and friend/family member to log onto the computer at least 15 minutes prior to the actual intervention … the co-investigator scheduled appointments'	**Continuous:** No **Real-time:** Yes **Asynchronous:** No Once-per-week scheduled Skype sessions	Available but not necessarily pastoral care 'If the elder or family member wanted to talk to the co-investigator about the experience, field notes were written.' (p.36)
Torp et al. (2008) 'To promote health among elderly informal carers	**Participants:** n = 19 **Focus:** Dementia carers	'Online discussion forum in which participants could provide information,	**Shared experience:** Carers **Shared characteristics:**	'Online discussion forum in which participants could provide information,	Professionals were invited to meetings to lecture on topics of interest to the carers.	**Continuous:** Access to information programs	'A call centre run by experienced health personnel … was established

Study (*aims*)	**Participant and evaluation characteristics**	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) / Mid blue = mostly meets (.66) / Light blue = partially meets (.33) / White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
caring for a relative with dementia or stroke at home by offering them ICT equipment.' (p.76)	**Country:** Norway **Age:** Mean 73, range 57-85 **Sex:** Mixed **Design:** Pre-post **Estimated effect size:** 0.552 **Outcome set:** Successful	pose questions … Participants could also get direct verbal and visual contact with each other by use of a videophone.' (p.76)	Older people in from two municipalities in eastern Norway	pose questions and receive answers from other participants in the network.' (p.76)	Carers agreed on the frequency of meetings and the agenda for each meeting. At carers' request, meetings were purely for carers. (p.77)	**Real-time:** Direct verbal and visual contact … by use of a videophone **Asynchronous:** Discussion forum	so that family carers could receive help related to the ICT … and also receive advice and support regarding their caring situation. (p.76-77)
Tsai and Tsai (2010)	**Participants:** n = 34 **Focus:** Nursing home residents **Country:** Taiwan **Age:** Mean 75, range 60-95 **Sex:** Mixed **Design:** Pre-post **Estimated effect size:** 0.036	Video conference with family - - no interaction with peers. Focus group findings 'Participants described having some physical limitations, feeling shy and having no idea what to talk	**Shared experience**: No peer-to-peer interaction. **Shared characteristics:** No peer-to-peer interaction.	No peer-to-peer interaction.	'Due to cost considerations, one fixed time was offered for participants to use the videoconferencing equipment.' (p.1541)	**Continuous:** No **Real-time:** Yes **Asynchronous:** No Once-per-week scheduled videoconference	'Helped to use the videoconference technology by a trained research assistant, who spent at least five minutes per week with residents at the appointment time.' (p.1540)

Study (*aims*)	Participant and evaluation characteristics	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) / Mid blue = mostly meets (.66) / Light blue = partially meets (.33) / White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
	Outcome set: Not successful	while using the videoconference equipment.' (p.1541)					
Tsai and Tsai (2011) '*To evaluate the long-term effectiveness of a videoconference intervention in improving nursing home residents' social support, loneliness, and depressive status.*' (p.1)	**Participants:** n = 90 **Focus:** Nursing home residents **Country:** Taiwan **Age:** Mean 74 **Sex:** Mixed **Design:** Controlled trial **Estimated effect size:** 0.051 **Outcome set:** Not successful	Video conference with family – no interaction with peers.	**Shared experience:** No peer-to-peer interaction. **Shared characteristics:** No peer-to-peer interaction.	No peer-to-peer interaction.	'Nursing home residents were asked to use the Internet at least once a week, with help from a trained research assistant.' (p.2-3)	**Continuous:** No **Real-time:** Yes **Asynchronous:** No Once-per-week scheduled videoconference	'Help from a trained research assistant, who spent at least 5 minutes per week with each resident' (p. 2-3)
Weinert et al. (2008) '*To determine the differences in the psychosocial status*	**Participants:** n = 183 **Focus:** Rural women chronic conditions **Country:** USA	'Peer-led support group (Koffee Klatch) … monitored by a research team member who	**Shared experience:** Chronic conditions	'Individuals go online to give and receive emotional support' (p.2)	'Forum was *for* and *by* the women, and although it was monitored by a	**Continuous:** Online self-study units **Real-time:** No	'Throughout the process, the women's health practitioner on the research team was

Study (*aims*)	Participant and evaluation characteristics	Evidence indicating the degree to which interventions meet each of the six 'Fund of Sociability' conditions Dark blue = fully meets (1) / Mid blue = mostly meets (.66) / Light blue = partially meets (.33) / White = does not meet (0)					
		Intimacy: Opportunity for unstructured discussion with peers	**Interaction:** Participants have shared experiences + characteristics	**Nurturance:** Sharing of experiences for others benefit encouraged / valued	**Self-worth:** Participant control over design / delivery and the terms of their participation	**Availability:** continuous + 'real-time' + asynchronous interactions	**Support:** Professionals available for pastoral care
of 3 groups of chronically ill rural women participating in a computer intervention.' (p.1)	**Age:** 52 **Sex:** Female **Design:** Randomized controlled trial **Estimated effect size:** 0.314 **Outcome set:** Partially successful	was an advanced practice nurse, the monitor did not take part in conversations.' (p.4)	**Shared characteristics:** Women from rural areas at least 25 miles from a town/city of 12,500 people on farm, ranch or small town	Focus group data 'All we can do, since I think we're in WTW because we are isolated, is support each other' (p.7)	research team member.' (p.4)	**Asynchronous:** Peer forum + expert-facilitated discussions	available daily to interact online with the participants regarding their health issues.' (p.4)
Weinert et al. (2011) *'To report the effect of a computer intervention on the psychosocial adaptation of rural women with chronic conditions.'* (p.82)	**Participants:** n = 309 **Focus:** Rural women chronic conditions **Country:** USA **Age:** Mean 56, range 35 - 65 **Sex:** Female **Design:** Randomized controlled trial **Estimated effect size:** 0.131 **Outcome set:** Not successful	'Peer-led asynchronous forum, Sharing Circle, in which the women exchanged feelings and life experiences, gave and received support, discussed issues'	**Shared experience:** Chronic conditions **Shared characteristics:** Women from rural areas at least 25 miles from a town/city of 12,500 people on farm, ranch or small town	'The virtual support group consisted of an asynchronous forum, Sharing Circle, in which the women exchanged feelings and life experiences, gave and received support' (p.84)	'peer-led virtual support group' (p.84)	**Continuous:** self-study health teaching units **Real-time:** No **Asynchronous:** forum	No mention of staff support.

Full Report

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